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Promoting preservice teachers' dual self-regulation roles as learners and as teachers: effects of generic vs. specific prompts

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Abstract Researchers have recently suggested that teachers must undertake important dual self- regulation roles if they want to become effective at improving their students' self-regulation. First, teachers need to become proficient at self-regulated learning (SRL) themselves, and then teachers need to learn explicitly how to proactively teach SRL – termed self-regulating teaching (SRT). Considering that both roles are difficult to attain by novice teachers, supports (prompts) are essential. We examined an intervention comparing the usefulness of two prompting conditions – generic versus specific – for developing both SRL (as learners) and SRT (as teachers) among 90 preservice science teachers engaging in explicit self-regulation instruction and reflective group discussion about learning/teaching experiences (observed learning clips, in-action teaching). We compared the two group conditions by using two SRL assessments and two SRT assessments. Mixed methods indicated that, as expected, the specific-prompts condition outperformed the generic-prompts condition on self-awareness of own SRL, skills for accurately noticing authentic videotaped students' SRL, and explicit usage of SRT during actual teaching experiences. As expected, no differences emerged between generic and specific prompts in applying SRT to a novel lesson-design task (far-transfer measure). These findings, supported by two case studies' sequential pattern analysis, offered an important contribution to theoretical and practical understanding of novice teachers' self-regulation prompting approaches, practice modes, and multidimensional assessments of teachers' professional development.

Keywords Dual learner/teacher role in SRL · Generic/specific prompts · Mixed-methods analysis · Lesson design (transfer) · Preservice teachers

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Self-regulation is considered to be critical for academic and lifelong success (Boekaerts 1999; Peeters et al. 2013). More specifically, in school settings, self-regulated learning (SRL) increases students' success in problem solving, motivation, and social relations (Cleary and Zimmerman 2004; Zimmerman 2002). Fortunately, research has indicated that, despite their complexity, SRL skills can be taught. Accumulating evidence has demonstrated how appropriate adjustments to teaching practices can enhance students' SRL development, pinpointing the vital role of teachers in promoting such self-regulatory processes (Bembenutty 2013; Dembo 2001; Kramarski and Revach 2009; Paris and Winograd 2003; Peeters et al. 2013; Perry et al. 2008; Randi 2004; Spruce and Bol 2014; Zimmerman 2002).

Growing consensus has indicated that teachers who want to become effective at improving their students' self-regulation must undertake important dual self- regulation processes themselves. First, teachers need to become proficient self-regulated learners themselves, and then teachers need to learn explicitly how to help students achieve SRL (Bembenutty 2013; Dembo 2001; Hattie and Yates 2014; Kramarski and Michalsky 2009, 2010; Peeters et al. 2013). Teachers' ability to achieve their own SRL is called the *learner's role*, and teachers' ability to proactively help students achieve personal SRL is called the *teacher's role* and may be termed SRT – self-regulating teaching (Hattie and Yates 2014; Kramarski 2016; Kramarski and Kohen 2015; Peeters et al. 2013). As just one example, with regard to the planning element of self-regulation, teachers in the SRL role set goals for their own planning, whereas teachers in the SRT role proactively guide students to plan a specific task.

To date, few researchers have focused on these dual roles for teachers, with intervention studies particularly lacking. In the current study, we aimed to fill this gap by examining an intervention that compared the effectiveness of two different self-regulation prompts – *generic* versus *specific* – which have previously been studied mainly to promote school students' SRL and academic achievements (Bol et al. 2012; Davis 2003; Davis and Linn 2000; Kistner et al. 2010; Koedinger and Aleven 2007; Kramarski et al. 2013b). Despite their potential for supporting self-regulation, these generic and specific prompts have not yet been sufficiently studied simultaneously as means to promote teachers' dual self-regulation roles: in regulating teachers' own learning (as learners – SRL) and in promoting their students' self-regulation (as teachers – SRT). In our current comparative investigation of these two prompting conditions' effectiveness, we focused on a sample of preservice teachers in view of the substantial research base indicating that novice learners and preservice teachers in particular experience difficulties applying self-regulation spontaneously (e.g., Butler et al. 2004; Kauffman et al. 2008; Kramarski and Michalsky 2010; Peeters et al. 2013). Thus, preservice teachers need stronger guidance in the form of prompts to attain the necessary knowledge and skills for successfully applying self-regulation in different aspects of learning and teaching contexts (Pintrich 2002; Veenman et al. 2006).

Preservice teachers' dual self-regulation roles

Teachers' self-regulation *as a learner* (SRL) involves constructive processes whereby teachers set goals and attempt to monitor and evaluate their own cognition, motivation, and behavior (Pintrich 2000; Zimmereman 2008). Self-regulation *as a teacher* (SRT) is similar, whereby teachers explicitly and proactively attend to *helping students* actively construct personal SRL. In both of the teacher's roles, self-regulation is a proactive process that does not merely happen *to* teachers but rather happens *by* them (Pintrich 2000; Zimmerman 2008).

Metacognitive and motivational elements in the SRL and SRT cycle. Overall, teachers' self-regulation (in both the SRL and SRT roles) builds on seven *metacognitive* and *motivational* elements related to learning and teaching (Pintrich 2000; Zimmerman 2008). Five of these elements indicate that teachers are good metacognitive regulators: *planning, information management, monitoring, debugging,* and *evaluation* (Schraw and Dennison 1994). Two elements are markers of teachers' motivation: *interest and value,* indicating intrinsic interest and attribution of value to the given task/knowledge; and *self-efficacy*, indicating teachers' belief in their own learning/teaching capability (Pintrich et al. 1993). Consistent with Zimmerman's (2008) self-regulation theory, these seven elements for SRL and SRT follow a cyclical process that includes three phases:

- In the *forethought* phase, teachers in the SRL role draw from prior experiences to inform planning and information management, whereas teachers in the SRT role proactively guide students in drawing from personal experiences to perform upcoming tasks.
- In the *performance* phase, teachers in the SRL role use their own goals to monitor and debug the process and move it along, whereas teachers in the SRT role proactively guide students in using personal goals as checkpoints for progress along tasks.
- In the *evaluation* phase, teachers in the SRL role use information gained from the completed task to improve performance on the next task, whereas teachers in the SRT role proactively guide students in examining what worked and what did not work.

These metacognitive strategies are accompanied by motivational strategies (interest and value, self-efficacy beliefs) about investing efforts into the SRL/SRT roles along the three phases of the cycle (see examples in the Measures section). Thus, attending to the three-phase cycle of metacognitive and motivational self-regulatory strategies enables teachers to become *self-aware, knowledgeable decision makers,* referring to teachers' ability to deliberately reflect on their own judgments and actions in order to justify "*why*" the teachers undertook these behaviors or made these decisions in their own learning (SRL) or while activating students' learning (SRT). The ability to generate such "justifications" indicates that teachers understand their own and their students' metacognitive and motivational processes (Kramarski 2016; Michalsky and Kramarski 2015; Pintrich 2002; Randi 2004; Schoenfeld 2010; Zimmerman 2008). It should be noted, however, that despite the theoretically cyclical nature of the self-regulation process, individuals can skip between different self-regulatory behaviors, leading to recursive sequential patterns within the cycle (Cleary et al. 2012).

SRT as a continuum of strategic instruction Specifically with regard to the teacher's role, beyond its seven metacognitive and motivational elements, SRT can also be investigated as an overall process of strategic instruction measured along a continuum (van Beek et al. 2014). At one end of the continuum is strong *external regulation* by the teacher (i.e., teachers' low level of SRT-oriented strategic instruction), which emphasizes the teacher's transmission of declarative knowledge – the "***what***" – to students. In the middle of the continuum, *intermediate regulation* (teachers' moderate level of SRT-oriented strategic instruction) is still connected with the teacher's presence, as in external regulation, but also includes the teacher's attempts to activate students' understanding of "***when***" and "***how***" by asking questions and demonstrating examples. At the other end of the continuum is strong *internal regulation* of learning by the students (teachers' high level of SRT-oriented strategic instruction), which allows students to think, discuss, correct, and reflect by themselves – to explore "***why***" things happen. Thus, high

levels of SRT-oriented strategic instruction by teachers place students at the centrum of autonomous learning, where the teacher's role is to proactively support and enhance that self-directed learning (Bolhuis 2003; Kramarski 2016; Schraw 1998; van Beek et al. 2014). Hattie and Yates (2014) have described the internally regulated end of the continuum as a high SRT process that occurs when teachers see learning in class through the eyes of students and help students to become "teachers" for themselves, thus making students' learning visible.

Reflective prompts for promoting preservice teachers' dual self-regulation roles

Reflection, defined as observing one's own thoughts, actions, and achievements, is an important aspect in the self-regulation process (e.g., Pintrich 2000; Zimmerman 2000). For less experienced teachers like those at the preservice stage, reflection is a major tool for supporting explicit self-regulation (Kohen and Kramarski 2012; Kramarski and Michalsky 2010; Pintrich 2002) and is also a central goal of teacher preparation (Schön, (1983. Implemented both in autonomous (individual) modes and collaborative (dyadic or group) modes, reflection affords comprehensive learning by thinking back and ahead along the cyclical self-regulation phases of learning and teaching practice (Zimmerman 2000). Reflection facilitates articulation of tacit knowledge as well as acquisition of learning and teaching strategies that provide teachers with opportunities to personally make sense of SRL and SRT promotion (Gordon et al. 2007; Kohen and Kramarski 2012; Kramarski and Michalsky 2010; Paris and Winograd 2003; Pintrich 2002; van Beek et al. 2014).

Despite the potential offered by reflective activity, research has indicated that preservice teachers' reflective capacity remains limited to mostly technical reflection (Davis 2006; Kauffman et al. 2008; Kohen and Kramarski 2012; Michalsky and Kramarski 2015; Randi 2004; Schön 1983). Preservice teachers show very little ability to implement various metacognitive and motivational self-regulation elements in their judgments and actions along the steps of the multiphase self-regulation cycle (Zimmerman 2000). As such, support for preservice teachers in the form of reflective prompts has been advocated as crucial in both the individual and group modes, for promoting teachers' dual self-regulation roles of SRL and SRT (Kramarski and Michalsky 2009; Peeters et al. 2013).

Reflective prompts are external stimuli like self-questioning or simple sentences that evoke strategy use, with the objective of enhancing SRL and SRT. Prompts provide the balance between necessary external support and desired internal regulation (Koedinger and Aleven 2007; Mevarech and Kramarski 1997, 2014). Prompts help teachers focus on their own or on students' thoughts, by thinking ahead and back in the self-regulation cycle, while engaging in activities involving individual interaction with materials (e.g., video clips, lesson plans) and while engaging in group discussions with peers about teaching/learning scenarios (Davis 2006; Kauffman et al. 2008; Kramarski and Michalsky 2009, 2010). From an instructional point of view, there are two vital ways to externally provide support for reflective self-regulation within SRL and SRT processes: generic and specific prompts. Specificity and contextualization distinguish generic from context-specific prompts.

Generic prompting Generic prompts stimulate an open-minded "top-down" thinking path (Saldana 2015; Salomon and Perkins 1989) that can be used across various situations and contents to focus attention. Generic prompts like "*Stop and think*" (Davis 2003) stimulate

critical reflective thinking about materials and experiences. The open-minded generic-prompts condition provides teachers with opportunities to autonomously and flexibly view their dual learner and teacher roles, to expand their repertoire of ideas, and to draw links and distinctions between the different self-regulation elements, thereby enriching teachers' reflective discussions (Kramarski 2016; Michalsky and Kramarski 2015).

Context-specific prompting Specific prompts stimulate a directed, "bottom-up" systematic thinking path (Saldana 2015; Salomon and Perkins 1989) that uses detailed statements or questions to promote self-regulation comprehension and implementation. Reflective specific-prompting steps like "*What did I notice about self-regulation? Explain why*" can help teachers to focus on their own or on students' thoughts, processes, and actions during reflective discussions, thereby achieving explicit knowledge about setting goals, planning, monitoring, and evaluation (e.g., Zimmerman 2002) while eliciting overt "why" justifications for actions and decisions. Thus, specific prompts assist preservice teachers in building an internal self-regulation model (Davis 2003).

Previous research on reflective prompts Simultaneous examination of both generic and specific prompts has mainly been conducted to prompt school students' scientific understanding and self-reflections, not teachers' behaviors, but research evidence has been inconsistent regarding these prompts' possible differential effects (Davis 2003; Davis and Linn 2000; Ifenthaler 2012; Kramarski et al. 2013b; Wu and Looi 2012). For example, generic prompts ("*Stop and think*") have yielded better results than specific prompts ("*What do I notice about…*?") for developing school science students' self-reflections and coherent understanding of scientific knowledge (Davis 2003). For school mathematics students, Kramarski et al. (2013b) also found better outcomes for generic prompts than for specific prompts regarding short-term transfer (routine algebraic tasks) and long-term transfer to a novel algebraic problem-solving task and to SRL (planning, monitoring, and evaluation). Likewise, Wu and Looi (2012) reported that two groups of school science students, who received either specific prompts ("*Can you explain the concepts*?") or generic prompts ("*What do you think about…*?") in an intelligent learning environment, did not differ on science-domain tasks, but the students receiving generic prompts succeeded more on a novel-domain task and revealed deeper reflection than those who received specific prompts.

Similarly, investigating university students, Ifenthaler (2012) found that generic prompts ("*Stop and think*") for planning and reflecting on challenging science problem-solving was more effective than specific prompts ("*The basic conditions to complete this virus infections problem were…*"). Findings indicated that the generic prompts were an important aid for developing metacognitive structures while solving problems. Ifenthaler concluded that the generic prompts guided learners to use a set of problem-solving strategies and at the same time gave them a certain extent of autonomy to self-regulate their problem-solving activities. On the other hand, the specific prompts seemed to prevent learners from solving a problem autonomously, but Ifenthaler suggested it could be helpful for novices who do not yet possess the necessary problem-solving skills.

In contrast, other research has favored specific prompts over generic ones. For example, Davis and Linn (2000) found that specific prompts directed to self-regulation in the science domain improved school learners' reflection more than generic prompts because the specific prompts (e.g., "*Claims in the article that we didn't understand included…*") stimulated a clear understanding of what learners were being asked to reflect upon. Similarly, McNeill and

Krajcik (2008) reported that specific prompts with an emphasis on explicit examples ("*Tell why properties…*") supported middle school students' "why" justifications of scientific explanations to a greater extent than generic prompts that asked for claims, evidence, and reasoning.

Accordingly, Aleven et al. (2006) claimed that for well-structured domains, prompts of a generic nature that ask students to "explain" and to "think" may be most effective because they allow students more latitude in discovering deficits in their own knowledge. However, in ill-defined domains, prompts of a specific nature, which ask students to interpret a situation, may be more likely to help them arrive at insightful interpretations compared to generic prompts.

Comparisons between generic and specific prompts remain lacking regarding their promotion of preservice teachers' dual self-regulation roles as embedded in learning/teaching experiences followed by reflective peer discussions. Prior studies that targeted preservice teachers' self-regulation have investigated either only generic prompts in well-structured contexts like mathematics (e.g., Kramarski 2008) or else only specific prompts in ill-structured pedagogical contexts as compared to a control condition (e.g., Kauffman et al. 2008; Kohen and Kramarski 2012), while focusing only on the learner role (SRL) without the teacher role (SRT). Likewise, the rare studies on reflective prompting in SRT experiences yielded similar separate findings for the teacher role – examining generic prompts in the well-structured mathematics context (Kramarski and Revach 2009) and specific prompts in the ill-structured pedagogical context (Kramarski 2016).

Recently, Michalsky and Kramarski (2015) compared generic and specific prompts jointly but only targeting the teachers' SRL role explicitly and not the SRT role. Three prompting conditions for teachers were directed to all three phases of the SRL cycle – planning, monitoring, and evaluation: *generic-prompts* reflections ("Stop and think"), *specific-prompts judgment* reflections ("thinking back"), and *specific-prompts modification* reflections ("thinking ahead"). These prompts were given while teachers analyzed ready-made videotaped lessons oriented to ill-structured pedagogical issues, where teachers were asked to consider the lessons' goals, contents, didactical materials, and learning environments. As expected for these ill-defined issues, results revealed that both of the specific-prompts approaches led to better performance than the generic-prompts approach on teachers' self-reflective judgments and modifications directed to SRL phases. Teachers who received one of the specific-prompts approaches also outperformed teachers who received the generic prompt on a transfer task – designing lessons that emphasized the added value of technology to enhance pedagogical issues. Improvement was more salient for the judgment-type prompt approach (thinking back) than for the modification-type prompt approach (thinking ahead). This study's findings added understanding about the different prompting approaches' benefits for preservice teachers, regarding SRL and lesson-design ability, which are essential for teachers' professional development.

However, prompts' effects on teachers' SRL and SRT have not yet been examined jointly in any single study. Research is still lacking about preservice teachers' dual SRL/SRT roles as emerging in ill-structured tasks like real-time learning and teaching experiences and as manifested in lesson-design transfer tasks oriented explicitly to SRT processes.

Current study design and objectives

To address preservice teachers' paucity of skills for dual self-regulation and critical reflection (Schön 1983), we assigned preservice secondary science teachers to one of two reflective conditions –

generic-prompts or specific-prompts – which prompted the preservice teachers to observe, analyze, and activate self-regulation both as learners and as teachers in their mandatory teaching methods course. Figure 1 illustrates the distinctions between our study's prompts in the two conditions. We aimed to examine if the critical reflection prompted in the two different conditions (top-down generic prompts versus bottom-up specific prompts) would be capitalized on differently by preservice teachers in their own learning (SRL) context compared to their own teaching (SRT) context (Kramarski 2016; Kohen and Kramarski 2016; Peeters et al. 2013; Randi 2004).

Based on literature indicating that authentic videotaped classroom scenarios are a highly valued, valid, authentic tool for comprehending teaching and learning (Seidel et al. 2013) and considering the complexity of self-regulation (Azevedo 2014; Greene and Azevedo 2010), in the current prompt-based intervention we focused on training the dual self-regulation roles in the context of reflectively analyzing, discussing, and engaging in videotaped learning/teaching scenarios. Specifically, we compared the effects of the generic-prompts and specific-prompts training conditions on preservice teachers using two declarative assessments of the SRL role and two process assessments of the SRT role. The SRL measures examined teachers' ongoing learning about their own SRL (self-reported SRL self-awareness as learners in the teaching methods course) and teachers' ongoing learning about authentic videotaped students' SRL (a measure of teachers' skills for accurately noticing SRL elements as manifested in observed students' behavior). The SRT measures examined real-time teaching (SRT-oriented teaching to proactively promote the personal SRL of peers who acted as students) and a novel non-prompted far-transfer task (designing a full science lesson unit oriented to SRT for proactively enhancing real high-school students' internally regulated, autonomous learning). Altogether in this study, we addressed the following two research questions:

Q1. Which prompting condition (generic or specific), would be more efficient for achieving the preservice teachers' dual roles as learners (SRL) and as teachers (SRT)?

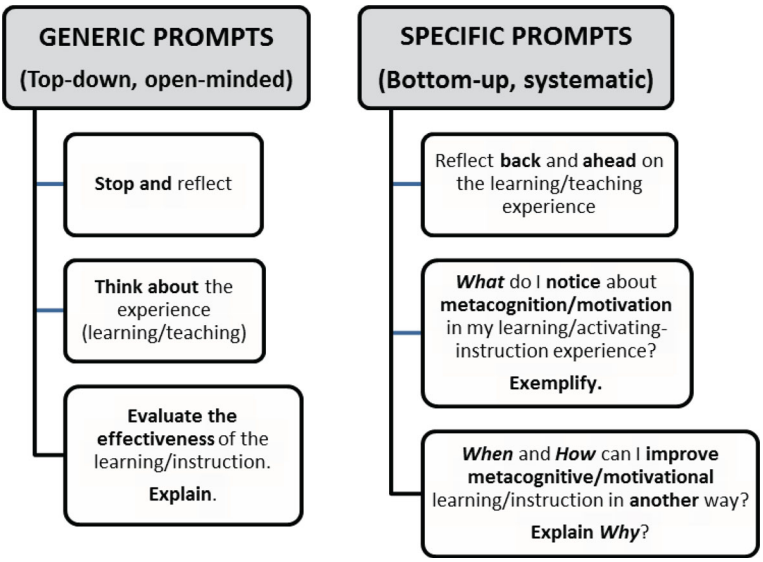


Fig. 1 Generic-prompt and specific-prompt reflection model for prompting preservice teachers' self-regulation in their dual roles as learners (SRL) and as teachers (SRT)

Q2. To what extent would preservice teachers' gains in the dual self-regulation skill sets in both roles be transferred to a novel, non-prompted knowledge-application task – designing lessons oriented to SRT?

We examined these research questions, first, by comparing the possible differential effects of the two prompting conditions on SRL and SRT gains for the two groups of participants (exposed to generic vs. specific prompts), and, second, by delving further into the previously under-investigated teacher role by examining the SRT processes and patterns of two individual preservice teachers, one case per condition. We formulated hypotheses in light of: (a) researchers' assertions that preservice teachers may be expected to need more explicit, systematic reflective support at the novice stage (Pintrich 2002; Veenman et al. 2006); (b) several prior claims that the systematic bottom-up specific-prompts condition might be a catalyst that fosters preservice teachers' use of SRL/SRT in ill-defined domains such as pedagogy education (Davis 2003; Ifenthaler 2012; Koedinger and Aleven 2007; Michalsky and Kramarski 2015); and (c) initial studies pointing to the benefit of specific prompts over generic prompts for preservice teachers' SRL (Kaufman et al. 2008; Kramarski 2016). Addressing Q1 for the group comparisons, we expected that the group of participants exposed to the specific-prompts condition would surpass the group exposed to the open-minded top-down generic-prompts condition in supporting the dual self-regulation roles. Addressing Q2 for the group comparisons, we expected that the two groups (exposed to generic vs. specific prompts) would yield similar outcomes, in light of previous research indicating that both generic and specific prompts hold merit for transferring knowledge to new contexts using different thinking paths (Aleven et al. 2006; Davis 2003; Ifenthaler 2012; Michalsky and Kramarski 2015; McNeill and Krajcik 2008; Salomon and Perkins 1989; Wu and Looi 2012).

In addition, we conducted in-depth pattern analysis of the under-investigated teacher role (SRT) for two case studies, following researchers who have discussed suitable assessment methods for self-regulation and have conceptualized it as a dynamic and complex series of events within an authentic setting – as a process that unfolds over time in a certain order within the self-regulation cycle (Azevedo 2014; Greene and Azevedo 2010; Molenaar and Järvelä 2014; Winne and Perry 2000; Zimmerman 2008). We selected one preservice teacher's case from each condition via purposeful sampling: Sara from the specific-prompts condition and Gail from the generic-prompts condition (pseudonyms). This expansion of the SRT measures' analysis to case studies aimed to address the phenomenon whereby individuals can jump between different self-regulatory actions inducing recursive sequential patterns within the self-regulation cycle (Cleary et al. 2012).

Thus, we conducted a comparison of Sara's and Gail's posttest measures of the teaching context (actual-teaching performance for peers and design of a lesson for a real high-school science class) while examining sequential pattern data and temporal appearances along the SRT cycle, considering *which* elements typically followed each other, *when* those elements appeared, and *how* they influenced each other over time (Molenaar and Järvelä 2014). We proposed the same hypotheses for the case studies' comparison as we did for the prompting groups' comparison regarding SRT outcomes, namely, that Sara (specific prompts) would surpass Gail (generic prompts) for the actual-teaching SRT measure (Q1) and that Sara would resemble Gail for the lesson-designing SRT measure (Q2). Yet, we expected to find different cyclical SRT sequential patterns (order) and temporal appearances (timing) between Sara and Gail along the cyclical three-phase self-regulation model (of forethought, action, and evaluation, Pintrich 2000; Zimmerman 2000), exhibiting the prompted thinking path (bottom-up and top-down, respectively).

Method

Participants

Groups Participants were 90 preservice teachers for high-school science (80 females, 10 males) in their second year of teacher education at a university in central Israel. Their mean age was 25.3 years ($SD = 4.50$), and they showed a good grade point average from the previous year courses studied in their science major ($M = 80$; $SD = 9.35$; range: 75–94). All participants were enrolled in the mandatory *Teaching Methods Practice* course and were assigned to one of two self-regulation prompting conditions (Fig. 1) for this course: specific prompts (three course sections totaling $n = 45$) or generic prompts (three course sections totaling $n = 45$). Statistical pretest comparisons showed no statistically significant demographic differences between the two learning conditions in sex, age, SES, ethnicity, or major grade point average; all Fs were: $F\ (1, 88) < 2$, $p > .05$.

Case studies Regarding the two cases that we sampled for in-depth examination, Sara from the specific-prompts condition and Gail from the generic-prompts condition, both preservice teachers exhibited: (a) similar demographic characteristics (a grade point average of 85 in their undergraduate science studies and no prior experience in actual classroom teaching); (b) similarly low pretest levels of self-regulation in their dual roles: low pretest SRL self-awareness scores (Sara: $M = 2.5$; Gail: $M = 2.4$) and low levels of SRT-oriented strategic instruction (high external regulation by the teacher) in their pretest lesson design (Sara: $M = 1.2$; Gail: $M = 1.3$); and (c) similarly high levels of engagement in the workshop discussions according to their instructors.

Professional instructors Six female instructors were selected for the *Teaching Methods Practice* course, three instructors per condition. Each instructor held a PhD in education, had more than 10 years of teaching experience, and was considered a good instructor according to institutional surveys of student satisfaction.

Intervention

Instructors' training Based on our experience from previous studies regarding training models and time durations for experienced instructors' training (Kohen and Kramarski 2016; Kramarski 2016; Kramarski and Michalsky 2009, 2010), each set of three instructors was trained separately by the second researcher in a 9-h inservice training seminar at the university. Instructors were told that they were participating in an experiment for enhancing teaching quality. Instructors were blind to the other condition. Consent to participate in the study was obtained from the instructors and the preservice teachers. The study was approved by the head of the university's teacher education program.

The first part of the training seminar was the same for both conditions. All instructors were exposed to explicit instruction in the same SRL/SRT theoretical framework (Schraw 1998; Zimmerman 2000), including the five elements of metacognition (planning, information management, monitoring, debugging, and evaluation; Schraw 1998) and the two elements of motivation (interest and value, and self-efficacy; Pintrich et al. 1993).

In the second part of the seminar, the two conditions' training differed according to the unique reflective sets of prompts, generic or specific, as presented in Fig. 1. Instructors received explanation of either the generic-prompts or specific-prompts rationale for stimulating SRL and SRT. Utilization of either the generic prompts or specific prompts was modeled to instructors while they viewed video clips of authentic teaching/learning scenarios on computer screens and while discussing those clips with other instructors. As seen in the figure, instructors in the generic-prompts condition learned to stimulate preservice teachers for top-down open-minded reflection using three prompting steps focusing generically on stopping to reflect, thinking, and evaluating/explaining (Aleven et al. 2006; Davis 2003; Ifenthaler 2012; Michalsky and Kramarsky 2015), whereas instructors in the specific-prompts condition learned to stimulate preservice teachers for bottom-up systematic reflection using three prompting steps focusing specifically on reflecting both backward and forward, noticing and exemplifying metacognition/motivation, and explaining when, how, and why to improve learning/instruction (Davis 2003; McNeill and Krajcik 2008; Michalsky and Kramarski 2015). Instructors were guided in procedures and scripts for stimulating preservice use of prompts (generic/specific) during preservice teachers': viewing of video clips from a pool of ready-made clips of authentic school students learning from expert/novice teachers (see Appendix); preparing for the real-time teaching task (at home); writing up of conclusions about viewed clips or about live peer-teaching scenarios (on the computer screen); preparing for reflective group discussions following each video clip's viewing and following each live peer-teaching scenario (with flashcards). See Fig. 2 for prompts' embedment throughout the intervention.

Each condition ($n = 3$ instructors) was trained with written protocols and scripts for presenting preservice teachers with either the generic-prompts or the specific-prompts condition's theoretical self-regulation framework, rationale, techniques for introducing prompts, and instructions for discussion. All training materials, including a table summarizing the study design and topics, were uploaded online for later access on the computer by instructors (see Fidelity section below for details).

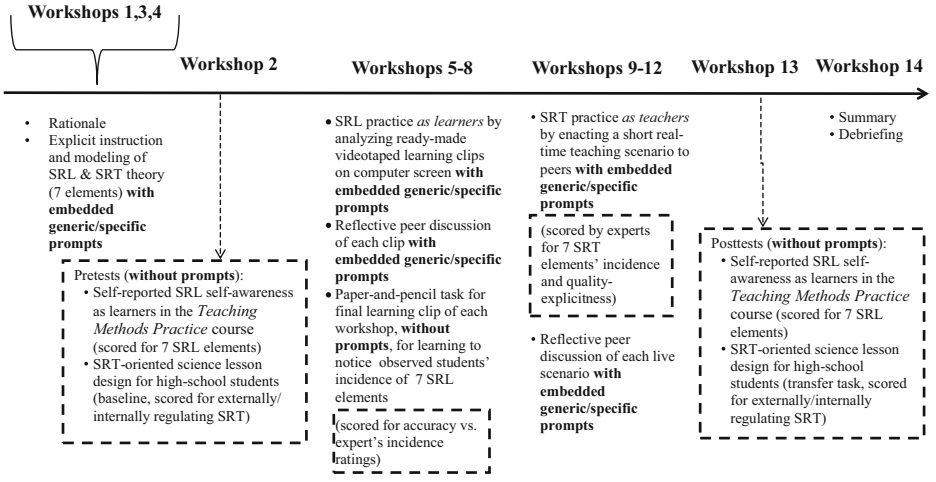


Fig. 2 Overview of the study design and timeline, with the four assessment measures presented in dotted boxes. SRL = self-regulated learning. SRT = self-regulating teaching

Preservice teachers' course curriculum and training stages In both conditions, the one-semester *Teaching Methods Practice* course comprised 14 workshops in a laboratory setting, lasting 2 academic hours each (totaling 28 h). As seen in the timeline presented in Fig. 2, during Workshops 1, 3, and 4, all participants were given the same study rationale ("an experiment for enhancing teaching quality") and the same theoretical cyclical model of self-regulation (Schraw 1998; Zimmerman 2008) with its focus on five metacognitive and two motivational elements, which were discussed for teachers' dual self-regulation roles (SRL and SRT). Note that during this explicit instruction and modeling of SRL and SRT theory, the two conditions differed only in the kind of embedded prompts (generic or specific) that they received either on the computer screen for analyzing ready-made learning/teaching clips or examples of SRL/SRT, or on flashcards to direct peer discussions. The two conditions were identical in Workshops 2 and 13, when preservice teachers completed pretest and posttest measures respectively, without prompts.

The core of the intervention (Workshops 5–12) focused on training the dual self-regulation roles in the context of analyzing videotaped learning and engaging in videotaped teaching. Workshops 5 to 8 focused on SRL practice *as learners*, where: (a) preservice teachers analyzed multiple video clips per workshop depicting school students' SRL in class scenarios, presented on the computer screen with reflective prompts (generic or specific) to stimulate preservice teachers' skills for noticing videotaped students' SRL; (b) preservice teachers summarized their main conclusions in writing on the computer (stimulated by generic/specific prompts) in preparation for ensuing reflective peer discussion (see Appendix); and (c) preservice teachers participated in group discussion (~30 min) prompted by flashcards (generic/specific) that aimed to increase preservice teachers' awareness of SRL.

In Workshop 5, preservice teachers received an explanation about the relationship between noticing (seeing) and knowing (Schön 1983). Noticing skills are frequently characterized in the teaching literature as crucial for teacher preparation (Seidel at al. 2013; Star and Strickland 2008) and as a prerequisite stage in order for teachers to later proactively help develop students' SRL knowledge through real-time acts of SRT (Zimmerman 2002). Thus, teachers' ability to accurately identify and describe the seven SRL elements, as noticed from authentic students' videotaped behavior, coincides with teachers' learner role, strengthening teachers' own SRL knowledge (Caspi et al. 2005; Muldner et al. 2013). At the end of each of these four workshops (5–8), regarding the videotaped students appearing in the final clip viewed that day, preservice teachers completed a paper-and-pencil task measuring the extent to which preservice teachers accurately noticed the incidence (presence) of the seven SRL elements in videotaped students' behavior, without teachers receiving explicit generic/specific prompts.

Workshops 9 to 12 focused on SRT practice *as teachers*, where each preservice teacher enacted a short (10-min) actual teaching scenario, with his/her preservice peers acting as students, which we videotaped for later coding. The teaching topics were taken from the high-school science curriculum mandated by the Ministry of Education. Preservice teachers in both conditions were explicitly asked before their exercise to plan (in writing at home) how, where, and why to proactively integrate SRT into their teaching topic based on the kind of prompts (generic/specific) to which they were exposed. Thus, the generic or specific prompts to utilize SRT were embedded in preparation for the teaching task. After their peer's actual teaching scenario, the preservice teachers were asked to take part in reflective group discussion about the scenario, which was stimulated by a flashcard presenting each preservice teacher with his/her respective generic or specific prompts (Santagata and Guarino 2011; van Es and Sherin 2002).

The final workshop (#14) summarized the course and included debriefing regarding the benefits of the prompting condition to which the preservice teachers had been exposed (generic or specific).

Fidelity To maximize fidelity, each of six instructors (three per condition) received a comprehensive manual that included a table summarizing the design of the experiment for enhancing teaching quality (without knowledge of the other condition), their prompting condition's theoretical principles, examples of SRL and SRT, and the course's detailed scripts, tasks/clips, prompts, procedures, and time allocation to each topic in all the course sessions. For example, instructors received a script for telling preservice teachers the importance of the study and for instructing preservice teachers in how to use reflective prompts while writing up conclusions on the computer screen, while preparing for peer discussion, etc. To ensure adherence to implementation of the instructional conditions, one researcher from the research team, who was blind to the aims of the study, observed each instructor six times (every second week) during the 14-week study period. In each observation, the researcher rated the extent (1-low to 4-high) to which the instructor implemented the intervention precisely regarding the course's scripts, tasks/clips, procedures, SRL/SRT instruction, reflective prompts, and discussion time allocation. Following each observation, the researcher met each instructor to discuss and amend any deviations from the management condition. Overall, implementation fidelity was extremely high (for the total observations: $M = 3.92$, $SD = 0.29$, range: 3–4). Deviations were minor, infrequent, and easily corrected (e.g., only on two occasions was reflective peer discussion time allocation rated less than 4 – rated 3 once for one generic-prompts instructor and once for one specific-prompts instructor).

Measures

Mixed qualitative and quantitative methods were used to measure the acquisition and activation of participants' dual self-regulation roles in the *Teaching Methods Practice* course and their application to a novel task.

Learner role: self-reported SRL self-awareness At the pretest and posttest intervals, preservice teachers self-reported the extent of their own SRL as learners in the *Teaching Methods Practice* course, by completing a paper-and-pencil self-report questionnaire without generic prompts or specific prompts. The 45-item questionnaire derived from two scales, with all items appearing in random order and rated on a 5-point Likert-type scale ranging from 1 (*Strongly disagree*) to 5 (*Strongly agree*). The questionnaire's 35 items relating to the five metacognitive elements of preservice teachers in the learner role (Cronbach alpha = .95) derived from the Metacognitive Awareness Inventory (Schraw and Dennison 1994): *planning* (e.g., "In the course, I think about what I really need to learn before I begin a task"); *information management* ("In the course, I focus on the meaning and significance of new information"); *monitoring* ("In the course, I find myself pausing regularly to check my comprehension"); *debugging* ("In the course, I change strategies when I fail to understand"); and *evaluation* ("In the course, I ask myself if there is an easier way to do things after I finish a task"). The questionnaire's 10 items relating to the two motivational elements of preservice teachers in the learner role (Cronbach alpha = .82) derived from the Motivated Strategies for Learning Questionnaire (Pintrich et al. 1993): *interest and value* (e.g., In the course, I prefer to

study material that will arouse my curiosity, even if it is hard material) and *self-efficacy* ("I am sure I could attain the skills taught in the course").

Learner role: noticing the incidence (presence) of SRL elements in videotaped students' behavior Immediately after watching the final ready-made authentic learning clip in each of Workshops 5 to 8, all preservice teachers received instructions "to observe and identify explicit metacognitive and motivational elements" manifested in the observed students' learning behaviors, without any generic or specific prompts. On these four occasions, preservice teachers completed a 7-item paper-and-pencil scale developed for the purpose of the current study, comprising one item each for noticing the incidence (presence) of the videotaped students' five metacognitive SRL elements (Schraw and Dennison 1994) and two motivational SRL elements (Pintrich et al. 1993). Preservice teachers rated each of the seven SRL elements globally across the entire final 10-min clip, on a 6-point Likert-type scale ranging from 1 (*no use* / *very, very low use*) to 6 (*very, very high use*).

Sample items for the metacognitive elements were: *planning* ("In the clip, the students related to planned goals/time sequences"); *information management* ("The students used different strategies/tools"); *monitoring* ("The students paused regularly to check their comprehension"); *debugging* ("The students reviewed information that was not clear"); and *evaluation* ("The students checked the final solution achieved in the task"). Sample items for the motivational elements were: *interest and value* ("The students expressed enthusiasm") and *self-efficacy* ("The students appeared confident and relaxed when learning").

Validity and reliability were calculated for this measure of noticing videotaped students' SRL. For validity, we first calculated a mean score for each preservice teacher for each of the seven elements, across the four observation clips. Then we calculated two mean scores for each preservice teacher, one for all the metacognition elements and one for both of the motivation elements. Following Bandalos and Finney's (2010) principles, we conducted exploratory factor analysis (21-SPSS version). First, unrestricted analysis with orthogonal rotation using the varimax method revealed three distinct factors with eigenvalues greater than one. Second, we conducted a restricted confirmatory analysis forcing the seven items onto two factors, *metacognition* and *motivation*, showing explained variance of 80.35 % (71.76 and 8.59 %, respectively). Items loadings were .35 to .68 for *metacognition* and .62 to .65 for *motivation*. The seven items were significantly correlated ($.39 < r < .61$; $p < .0001$), and the two factors were highly correlated ($r = .70$; $p < .0001$). To check reliability, Cronbach alphas were calculated, yielding high reliabilities of .90 for the metacognition factor and .80 for the motivation factor.

Finally, we assessed the preservice teachers' accuracy in noticing videotaped students' SRL by comparing the teachers' ratings of SRL elements' incidence (presence) in the videotaped authentic learning scenarios to the ratings of an expert who underwent training to analyze these students' SRL. Inter-rater comparison yielded higher agreement for the specific-prompts group with the expert, ranging from 88 to 82 % across the seven metacognition and motivation elements, with the highest correspondence with the expert manifested on the planning and evaluation elements. In contrast, the generic-prompts group's comparison with the expert's ratings yielded lower agreement, ranging from 68 to 74 % across the seven metacognition and motivation elements.

Teacher role: SRT in real-time teaching to peers (as students) The 10-min actual science teaching scenario enacted by each preservice teacher, to proactively promote the

SRL of his/her preservice peers, was videotaped for later coding. Two independent raters, doctoral students with expertise in SRL who were blind to the existence of the two experimental conditions, underwent training to analyze these videotapes and to code for SRT *incidence* and *quality*. The teaching scenario data were transcribed and then viewed multiple times line by line to identify "SRT events" from verbal statements in the data, depicting events where preservice teachers proactively helped promote the five metacognitive elements and two motivational elements of SRL in their peer-enacted students. Videotapes were viewed to identify categories for the seven elements and conceptual connections between each category and its subcategories. Raters discussed the elements' categories to define and refine the concepts and subconcepts to elicit their interpretations, explanations, and meanings, until reaching full agreement (Strauss and Corbin 1990). The metacognitive and motivational element categories were easily identified according to the SRL theories of Zimmerman (2008) and Schraw (1998) as a consequence of previous experience in similar analyses (Kohen and Kramarski 2012; van Beek et al. 2014).

SRT incidence Incidence referred to the **presence** of the seven SRT elements across the 10-min teaching scenario, with trained raters utilizing the following definitions (Pintrich et al. 1993; Schraw and Dennison 1994): (1) *planning:* The teacher guides students to set goals to improve their learning, resource allocation, time allocation; (2) *information management:* The teacher helps students to select strategies to enhance their information processing (e.g., organizing, elaborating, summarizing); (3) *monitoring:* The teacher guides students to be aware of and assess their comprehension; (4) *debugging:* The teacher helps students to handle misunderstandings; (5) *evaluation:* The teacher asks students to reflect on their comprehension after a teaching scenario; (6) *interest and value:* The teacher encourages students' enthusiasm (e.g., group work); and (7) *self-efficacy:* The teacher stimulates students' confidence in discussion (e.g., giving feedback).

SRT quality Quality referred to the **implicitness/explicitness** of the seven elements, rated according to preservice teachers' justifications for elements' use. Trained raters coded each preservice teacher's verbal statements along the following 4-point quality scale (0–3): *No use of the element* (Score = 0); *Implicit use of the element ("**what**") without stating justification* (Score = 1); *Implicit use of the element, stating partial justification of "**when**" and "**how**" by referencing students' activation* (Score = 2); *Explicit use of the element by naming or discussing it, clearly stating "**why**" justifications by referencing students' activation* (Score = 3). For example, the verbalization "*To start,… I will remind you of the definition of an arithmetic series*" would be scored 1 (implicit goal setting of "**what**" without stating justification); the verbalization "*Don't forget to check your solution*" would be scored 2 (implicit referencing to the evaluation element with partial justification of "**when**" and "**how**" and with referencing to students' activation); the verbalizations "*Let's discuss the use of goal setting as a strategy*" and "*The purpose is to exercise thinking, the meta-cognition… and not just to throw out anything that comes to mind*" would be scored 3 (explicit referencing to the planning element with "**why**" justification for its implementation and with referencing to students' activation in discussion).

Thirty percent of the responses were coded initially to calculate inter-rater reliability, yielding high Cohen's Kappa reliability coefficients ranging from .87 to .93 for incidence and quality. Disagreements on coding of SRT elements' incidence and quality were resolved through discussion.

Teacher role: lesson design oriented to SRT (novel far-transfer task) At both the pretest and posttest intervals, each preservice teacher was given 1.5 h to perform a novel non-prompted task: to design a written teaching unit in the authentic context of a high-school science lesson (on the "effects of the ecological environment on people's lives" for the pretest and on the "effects of smoking on people's lives" for the posttest). Preservice teachers were instructed to base their lesson design on what they had learned in the current course and in other teacher education courses, but no explicit prompts (specific or generic) were supplied for preservice teachers to use SRL elements in their designs or to use instructional strategies that would proactively stimulate these elements in students (SRT). This far-transfer task required high-order lesson-design skills (Jacobson and Archodidou 2000; Koehler and Mishra 2005; Zohar 2006).

Thus, this transfer task was novel in its: (a) lack of explicit prompts (generic/specific) to use SRL and SRT, whereas the course consistently supplied such prompts for all training tasks; (b) lesson planning for an authentic context of unknown high-school science students, whereas lesson planning assigned in the course had targeted familiar preservice teachers peers playing the role of students; (c) 1.5-h time in the course session for designing a detailed full lesson, whereas preservice teachers had prepared a short (10-min) teaching scenario at home; (d) written format differing from the course's videotaped training activities; (e) lack of access to preservice teachers' books and notebooks from the experimental course and other teaching courses when performing this task, whereas the course's tasks afforded access; and (f) science subject matters (ecology, smoking) that were not systematically or explicitly addressed in the course.

Two graduate students with expertise in SRT-oriented strategies for lesson designs, who were blind to the existence of the two experimental conditions, underwent training to code the preservice teachers' lesson designs along the SRT-orientation continuum of *external to internal regulation* of learning. These independent expert raters divided the written lesson-design units into statements representing meaningful events (Strauss and Corbin 1990) and analyzed each event using a 4-point coding scheme (0–3) for SRT-oriented strategic instruction (Kohen and Kramarski 2012; van Beek et al. 2014) as follows. No use of strategic instruction oriented to SRT, just referencing to content, received a score of 0 (e.g., "The topic is damage from smoking"). A focus on the *teacher as a proactive external regulator* (e.g., transmitting information), supported by a "**what**" justification, was scored 1 (e.g., "I will present the main ecology concept with a short video"). A focus on the *teacher as an intermediate regulator* (still proactive but stimulating students, asking questions, demonstrating), supported by "**when**" and "**how**" justifications, was scored 2 (e.g., "After watching the video students will answer how smoking affects the human body").

A focus on the *teacher setting up the classroom to proactively empower the student to act autonomously as an internal regulator* (e.g., student discusses, reflects by using group work or self-guided questions), supported by fully justified "**why**" considerations related to students' needs to enhance SRL (e.g., monitoring the solution process), was scored 3 (e.g., "Students will discuss the solution process in small groups to understand how it can be harmful for human beings").

Thirty percent of the responses were coded initially to calculate inter-rater reliability, yielding high Cohen's Kappa reliability coefficients for SRT-oriented strategic instruction at Time 1 (ranging from .86 to .91) and at Time 2 (ranging from .84 to .90). Disagreements on coding of SRT-oriented design skills were resolved through discussion.

Teacher role: case-study analyses of SRT patterns For Gail's and Sara's actual 10-min teaching scenario, beyond computing SRT incidence (presence) and quality (explicitness), we also examined sequential and temporal patterns of these two preservice teachers' performed metacognitive and motivational SRT elements. In particular, in the real-time teaching scenario we examined the movement and path of each teacher's performed SRT events (elements), marking the timing of high concentrations of events along the 10-min task. If the teacher's focus (high incidence of events) was on the planning and information management elements (forethought phase), we called this a top-down thinking path, whereas if the teacher's focus was on the metacognitive in-action regulatory elements (monitoring, debugging, and evaluation), we called it a bottom-up thinking path (Saldana 2015; Salomon and Perkins 1989; see Fig. 3). Likewise, for Gail's and Sara's written lesson designs at pretest and posttest, beyond computing SRT-oriented strategic instruction (on continuum from teacher's external regulation to students' internal regulation), we also examined the sequential patterns of the performed SRT metacognitive and motivational events.

The case studies were analyzed by two independent raters, experts in SRT who were blind to the cases' prompting condition. High inter-rater reliability emerged for real-time SRT and for SRT-oriented strategic instruction (92 % agreement between the raters).

Results

The learner's role (SRL)

Self-reported self-awareness, by group One-way multivariate analysis of variance (MANOVA) for the pretest measuring preservice teachers' self-awareness about the seven SRL elements indicated no statistically significant differences between the two conditions, $F(7, 82) = .93$, $p > .05$, $^{2} = .07$. This non-significant result on the omnibus MANOVA pretest further diminishes the threat of selection bias of possible non-equivalent groups.

Table 1 presents the findings of the follow-up ANOVAs for SRL self-awareness, with repeated measures for the seven self-reported SRL elements, with prompting condition (generic/specific) and time (pretest/posttest) as independent variables. Findings revealed a statistically significant main effect for Time, $F(7, 81) = 6.68$, $p < .0001$, $^{2} = .37$. At the end of the intervention, preservice teachers in both conditions had increased their self-perceived motivational interest and value and their self-efficacy. ANOVAs with repeated measures for the metacognitive and motivational elements revealed a statistically significant interaction for Time by Condition. At the end of the intervention, the specific-prompts condition reported statistically significant higher gains in their metacognitive SRL scores for information management ($d = 0.73$), monitoring ($d = 0.65$), and debugging as learners ($d = 0.35$) and in their motivational SRL scores for interest and value ($d = 0.63$) and self-efficacy ($d = 0.67$), compared to the generic-prompts condition where scores did not show statistically significant changes for the metacognitive elements and showed only low changes for the motivational scores: interest and value ($d = 0.31$) and self-efficacy ($d = 0.36$).

Noticing videotaped students' SRL, by group A one-way MANOVA for preservice teachers' accurate noticing of the incidence (presence) of videotaped students' seven SRL elements yielded a statistically significant main effect for Condition (generic/specific prompts),

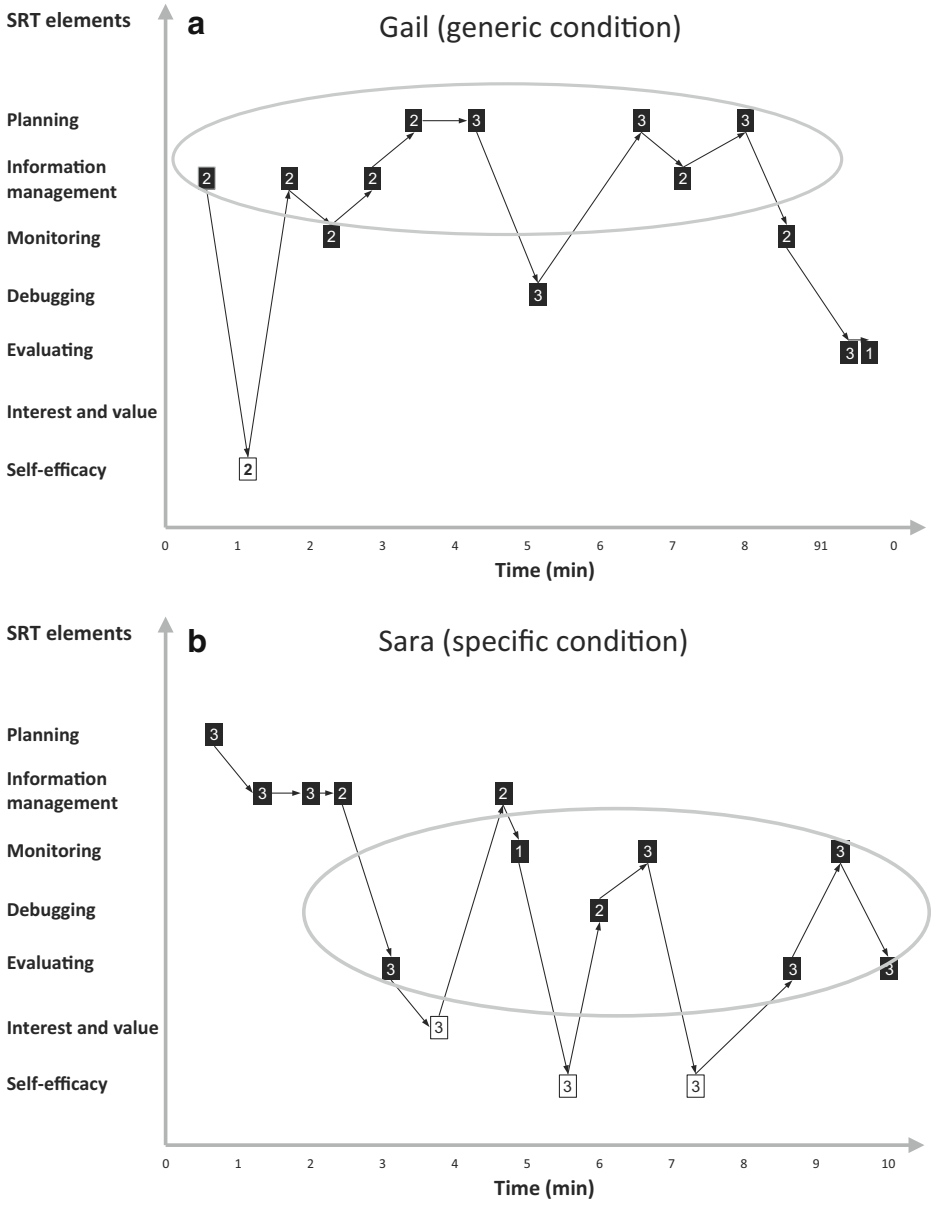


Fig. 3 The SRT elements by sequence and time, as coded by experts across Gail's (GP condition – 3a) and Sara's (SP condition – 3b) 10-min. actual teaching scenario. Scores for quality of self-regulating teaching (SRT) are presented in squares, ranging from 1-implicit to 3-explicit justification of *why.* Metacognitive elements appear in blue; motivational elements appear in red. The ovals indicate that Gail focused mostly on the forethought elements (P & IM) and Sara mostly on the controlling metacognitive elements (M, D, E)

$F(7, 81) = 3.43, p < .001,\ ^2 = .03$. As seen in Table 2, the ANOVAs revealed that the group of preservice teachers in the specific-prompts condition noticed four of the self-regulatory elements in the observed students significantly more often than the group of preservice teachers in the generic-prompts condition: planning ($d = 0.29$), evaluation ($d = 0.37$) , interest

Table 1 Learner role – preservice teachers' self-reported srl self-awareness: means, standard deviations, and F Values by time and condition

Self-reported SRL elements	Specific-prompts condition ($n = 45$)				Generic-prompts condition ($n = 45$)						F (1, 86)	
	Pretest		Posttest		Pretest		Posttest		Time	η^2	Time X Condition interaction	η^2
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*				
Metacognition												
Planning	4.05	0.45	4.29	0.87	4.17	0.50	4.15	0.69	1.57	.02	2.16	.02
Information management	3.70	0.41	4.00	0.56	3.87	0.41	3.82	0.77	2.93	.03	5.41*	.06
Monitoring	3.90	0.43	4.18	0.57	3.99	1.29	3.81	0.92	.20	.00	3.98*	.04
Debugging	4.01	0.43	4.16	0.67	4.07	0.65	3.78	0.90	.69	.01	6.65*	.07
Evaluation	3.86	0.48	4.09	0.65	3.84	0.65	3.83	0.81	1.84	.02	2.19	.03
Motivation												
Interest and value	3.97	0.51	4.29	0.44	3.98	0.59	4.16	0.68	13.72***	.14	.98	.01
Self-efficacy	4.03	0.54	4.39	0.52	4.09	0.66	4.33	0.58	32.89***	.27	1.18	.01

SRL = self-regulated learning (learner role). Scores ranged from 1 to 5

* $p < .05$. *** $p < .001$

and value ($d = 0.58$), and self-efficacy ($d = 0.32$) Similar levels of noticing skills were found between the two conditions concerning the videotaped students' information management, monitoring, and debugging elements.

Table 2 Learner role – preservice teachers' noticing of students' SRL elements: means, standard deviations, F Values, and Cohen's d scores, by condition

Noticed SRL elements in observed students' behavior	Specific-prompts condition ($n = 45$)		Generic-prompts condition ($n = 45$)		d	F (1, 86)	η^2
	M	*SD*	*M*	*SD*			
Metacognition							
Planning	4.64	0.32	4.55	0.30	.29	4.25*	.01
Information management	4.72	0.22	4.69	0.29	.12	.88	.00
Monitoring	4.54	0.33	4.47	0.49	.17	1.79	.00
Debugging	4.76	0.21	4.70	0.38	.20	2.83	.00
Evaluation	4.71	0.23	4.59	0.44	.37	7.57**	.01
Motivation							
Interest and value	4.66	0.33	4.45	0.39	.58	20.43***	.02
Self-efficacy	4.69	0.27	4.59	0.35	.32	5.76*	.01

Scores ranged from 1 to 6. Cohen's d was calculated as the ratio between the two conditions' discrepancy (specific-prompts condition minus generic-prompts condition) and the two conditions' average standard deviation

* $p < .05$. ** $p < .01$. *** $p < .001$

The teacher's role (SRT)

SRT in real-time teaching to peers (as students), by group The SRT performed by preservice teachers in their 10-min actual teaching scenarios to proactively promote students' (peers') metacognitive and motivational SRL elements was analyzed by experts to compare the two conditions' for mean SRT *quality* (explicitness, see Table 3) and for SRT *incidence* at each quality level (frequencies and percentages, see Table 4). A one-way MANOVA followed by ANOVAs for SRT *quality* demonstrated a statistically significant main effect for Condition (generic/specific prompts), $F\ (7,\ 74) = 5.87$, $p < .0001$, $^{2} = .36$. Preservice teachers in the specific-prompts condition were rated by experts as displaying statistically significant higher quality levels, depicting more explicit SRT usage, compared to the generic-prompts condition. In particular, large significant differences emerged between the two prompting conditions, favoring the specific-prompts condition, in the quality (explicitness) of SRT for four of the five metacognitive elements: planning, information management, monitoring, and evaluation. As seen in Table 3, the largest differences between the two conditions during real-time teaching were for explicitness in planning ($d = .94$) and monitoring ($d = .90$) and less for information management ($d = .68$) and evaluation ($d = .62$). As for the motivational elements, experts rated preservice teachers in the specific-prompts condition as statistically significantly surpassing the generic-prompts condition in explicitly raising students' (peers') greater interest and value ($d = .83$) and self-efficacy ($d = .63$) attributed to learning. No statistically significant differences were found between the conditions in the SRT quality for the debugging element.

As seen in Table 4, statistically significant differences also emerged between the generic-prompts and the specific-prompts conditions for the expert-rated *incidence* of preservice teachers' actual SRT targeting their students' (peers') learning, both for the total metacognition and motivation scores and for six of the seven metacognitive and motivational elements, all

Table 3 Teacher role – SRT quality ratings from preservice teachers' 10-min actual teaching scenario: means, standard deviations, F Values, and Cohen's d scores, by condition

Expert-rated SRT elements' quality (explicitness) in actual teaching	Specific-prompts condition ($n = 45$)		Generic-prompts condition ($n = 45$)		d	F (1, 80)	η^2
	M	*SD*	*M*	*SD*			
Metacognition							
Planning	2.47	0.52	2.02	0.44	.94	17.78***	.18
Information management	2.50	0.41	2.20	0.46	.68	9.25**	.10
Monitoring	2.32	0.44	1.87	0.56	.90	15.80***	.17
Debugging	2.32	0.85	2.11	0.75	.26	1.46	.02
Evaluation	2.42	0.66	2.02	0.64	.62	7.58**	.09
Motivation							
Interest and value	2.73	0.51	2.07	0.78	.83	19.79***	.20
Self-efficacy	2.59	0.54	2.22	0.62	.63	8.28**	.09

SRT = self-regulating teaching (teacher role). Quality scores ranged from 0 to 3, with higher scores indicating greater SRT explicitness. Cohen's d was calculated as the ratio between the two conditions' discrepancy (specific-prompts condition minus generic-prompts condition) and the two conditions' average standard deviation

** $p < .01$. *** $p < .001$

Table 4 Teacher role – SRT incidence ratings from preservice teachers' 10-min actual teaching scenario: frequencies, percentages, and chi-square tests, by quality and condition

Expert-rated SRT elements		Incidence: Frequency (Percentage[a])								Wald
		Specific-prompts condition ($n = 45$)				Generic-prompts condition ($n = 45$)				
Quality level		0	1	2	3	0	1	2	3	
Metacognition										
P	Planning	0(0 %)	2 (4 %)	18(40 %)	25 (56 %)	0(0 %)	6(11 %)	35(78 %)	6(11 %)	17.41***
IM	Info. management	0(0 %)	2(4 %)	17(38 %)	26(58 %)	0(0 %)	1(2 %)	34(71 %)	12(27 %)	8.77**
M	Monitoring	0(0 %)	2(4 %)	27(60 %)	16(36 %)	0(0 %)	9(16 %)	30(67 %)	8(18 %)	7.73**
D	Debugging	2(4 %)	6(13 %)	15(33 %)	22(49 %)	0(0 %)	10(22 %)	20(44 %)	15(33 %)	2.51
E	Evaluation	0(0 %)	3(7 %)	13(29 %)	29(64 %)	0(0 %)	5(11 %)	25(51 %)	17(38 %)	7.27**
Total [b]		2(1 %)	15(7 %)	90(40 %)	118(52 %)	0(0 %)	27(12 %)	138(62 %)	56(25 %)	20.05***
Motivation										
IV	Interest and value	0(0 %)	2(4 %)	9(20 %)	34(76 %)	1(2 %)	9(18 %)	22(49 %)	15(31 %)	18.14***
SE	Self-efficacy	0(0 %)	2(4 %)	6(13 %)	37(82 %)	0(0 %)	2(4 %)	20(40 %)	25(56 %)	8.60***
Total [c]		0(0 %)	4(4 %)	16(17 %)	71(79 %)	1(1 %)	11(11 %)	38(44 %)	37(43 %)	18.88***

SRT = self-regulating teaching (teacher role). Quality score: 3 = Explicit element use, clearly stating "why" justification; 2 = Implicit element use, stating partial "when" and "how" justifications; 1 = Implicit element use ("what") without justification; 0 = No element use

[a] Except for totals, percentages out of 45 (total participants per condition)

[b] Percentages out of total metacognitive elements per condition: 225 for specific-prompt condition, 221 for generic-prompt condition

[c] Percentages out of total motivational elements per condition: 91 for specific-prompt condition, 87 for generic-prompt condition

* $p < .05$. ** $p < .01$. *** $p < .0001$

except debugging. The main differences between the two conditions emerged for the incidence of those SRT behaviors performed in preservice teachers' actual teaching that the experts scored the highest, as 2 or 3. That is, a higher percentage of preservice teachers in the generic-prompts condition than in the specific-prompts condition was rated with a quality score of 2, indicating preservice teachers' performance of implicit SRT behaviors that only stated "when" and "how" justifications for activating students. Namely, for metacognition, 62 % of the generic-prompts group vs. only 40 % of the specific-prompts group received a quality score of 2, and for motivation, 44 % of the generic-prompts group vs. only 17 % of the specific-prompts group received a quality score of 2. However, for the quality score of 3, findings were reversed: A higher percentage of preservice teachers in the specific-prompts condition than in the generic-prompts condition was rated as explicitly using SRT elements that clearly stated "why" justifications by referencing students' activation (52 % of specific-prompts group vs. 25 % of generic-prompts group for metacognition and 79 % of specific-prompts group vs. 43 % of generic-prompts group for motivation). Thus, overall, the preservice teachers in the specific-prompts condition achieved a higher incidence of the highest quality (most explicit) SRT behaviors for promoting their students' (peers') SRL during real-time teaching, compared to the generic-prompts condition.

To complete this group comparison using more statistically inferable modeling (Greene et al. 2011), we employed the ordered logit model to estimate the probability (threshold) at which a preservice teacher would receive higher SRT scores (Cameron and Trivedi 2013). For this comparison, the dependent variable was preservice teachers' frequency scores (1–3) on each SRT element, with specific versus generic condition rating as an explanatory variable. Wald value calculation (see Table 4) and *b* coefficients of the ordered logit analysis showed that the prompting condition effect (specific vs. generic) was significant for the explicitness of six of the seven elements, all except debugging: *planning*: $b = 2.11$, $p < .001$; *information management*: $b = 1.33$, $p < .001$; *monitoring*: $b = 1.25$, $p < .001$; *evaluation*: $b = 1.16$, $p < .01$; *interest:* $b = 2.00$, $p < .001$; *self-efficacy:* $b = 1.48$, $p < .001$. For all these elements, preservice teachers in the specific-prompts condition surpassed those in the generic-prompts condition in achieving the highest quality of actual SRT behavior (expert-rated score of 3).

Lesson design (far-transfer task) oriented to SRT, by group The one-way ANOVA on the preservice teachers' SRT-oriented strategic instruction (*external/internal regulation*) as measured from their lesson design at the pretest interval demonstrated no statistically significant effect for Condition (generic/specific prompts), $F\ (2,\ 87) = 2.25$, $p > .05$, $^2 = .08$. However, as seen in Table 5, the two-way ANOVA with repeated measures [Time: (pretest/posttest) x Condition (generic/specific prompts)] on the lesson designs' SRT-oriented strategic instruction scores indicated a statistically significant effect for Time, $F\ (1,\ 88) = 27.71$, $p < .0001$, $^2 = .26$, but no statistically significant interaction between Time and Condition, $F\ (1, 87) = .58$, $p > .05$, $^2 = .01$. The statistically significant Time effect indicates that, among both conditions, preservice teachers improved over time in lesson-design skills that focus on proactively promoting students' internal regulation of learning, justified by why considerations.

SRT patterns in teaching and lesson design, by case We explored SRT in depth for two case illustrations, one sampled from each group: Gail from the generic-prompts condition versus Sara from the specific-prompts condition.

Table 5 Teacher role – preservice teachers' SRT-oriented lesson design (far-transfer): means, standard deviations, F Values, and Cohen's d scores, by time and condition

Expert-rated SRT behaviors' external/internal regulation focus	Specific-prompts condition ($n = 45$)					Generic-prompts condition ($n = 45$)					F (1, 86)			
	Pretest		Posttest			Pretest		Posttest			Time	η^2	Time X Condition interaction	η^2
	M	*SD*	*M*	*SD*	*d*	*M*	*SD*	*M*	*SD*	*d*				
	2.02	.23	2.29	.32	0.9	2.07	.36	2.27	.32	0.7	27.71***	.26	.58	.01

Scores ranged from 0 to 3, with higher scores indicating greater internal student regulation. Cohen's *d* was calculated as the ratio between the pre-post discrepancy (posttest minus pretest scores) and the average standard deviation of the pretest scores

*** $p < .001$

SRT incidence, quality, and sequential/temporal patterns in actual teaching, by case We compared the two cases by elaborating on the prior SRT assessments to examine sequential patterns (order), temporal appearances (timing), and thinking paths (bottom-up and top-down, respectively). Table 6 presents the incidence (presence) and quality (explicitness) of Sara's and Gail's SRT events (metacognition and motivation) and their elements' pattern in sequence, as analyzed by experts from each of the two preservice teachers' actual 10-min peer-teaching scenarios. Figure 3a and b illustrate, respectively, Gail's and Sara's movement-by-movement SRT-event sequential patterns, across each preservice teacher's actual teaching scenario, indicating the quality scores (1–3) given to each event.

Comparison of these two cases revealed that, overall, Sara and Gail did not differ in their total incidence of SRT events, demonstrating 15 and 14 events, respectively. However, the two

Table 6 Teacher role – SRT incidence, quality, and sequential patterns rated from sara's and gail's 10-min actual peer teaching scenario

Expert-rated SRT elements in actual teaching	Sara (Specific-prompts condition)		Gail (Generic-prompts condition)	
	Incidence	Quality	Incidence	Quality
Metacognition				
P Planning	1 (6.6 %)	3	4 (29.0 %)	2.75
IM Information management	4 (27.0 %)	2.5	4 (29.0 %)	2
M Monitoring	3 (20.0 %)	2.33	2 (14.0 %)	2
D Debugging	1 (6.6 %)	2	1 (7.0 %)	3
E Evaluation	3 (20.0 %)	3	2 (14.0 %)	2
Motivation				
IV Interest and value	1 (6.6 %)	3	0 (0.0 %)	0
SE Self-efficacy	2 (13.2 %)	3	1 (7.0 %)	2
Total / mean	15 (100.0 %)	2.69	14 (100.0 %)	1.96
Sequential pattern (over 10-min. scenario)	P, IM, IM, IM, E, IV, IM, M, SE, D, M, SE, E, M, E		IM, SE, IM, M, IM, P, P, D, P, IM, P, M, E, E	

SRT = self-regulating teaching (teacher role). Quality (explicitness) of SRT events was scored on a range of 0–3

teachers did differ in the extent to which they revealed highly explicit and well-justified (high quality) SRT along their actual peer-teaching scenario. As seen in Fig. 3b, 11 of Sara's 15 SRT events (73 %) were scored 3, whereas as seen in Fig. 3a, only 5 of Gail's 14 SRT events were scored 3 (36 %), showing consistently higher quality ($M = 2.69$) for the specific-prompts participant than for her generic-prompts counterpart ($M = 1.96$).

Differences also emerged between the two preservice teachers regarding the reflective thinking path manifested by the cyclical sequence in which their SRT elements appeared during real-time teaching, as seen in Table 6 and as illustrated by the timelines and ovals in Fig. 3. Thus, Sara, who experienced the bottom-up specific-prompts condition directing her to "*Reflect back and ahead on the teaching experience,*" started with the forethought SRT phase of the cyclical three-phase self-regulation model – by referencing planning and information management, and then she followed with the monitoring and then evaluation phases. Sara alternated between different elements for stimulating her peer students' metacognition (about 80 % of her events) and motivation (about 20 % of her events), focusing systematically on metacognitive regulation elements across the action and evaluation phases along the 10-min experience (47 % of the events as shown in the oval on Fig. 3b).

As seen in the temporal pattern of Sara's SRT events (see Table 6 and Fig. 3b), at first, in the forethought phase, she briefly stated the goal of the real-time teaching scenario and elaborated it with information management strategies (about 2 min). Then, in the action phase that was intertwined with the evaluation phase, she started to stimulate her peer students to regulate their actions (after 3 min) and continued to do so in almost each minute, by using different kinds of SRT elements like proactively guiding students to monitor, to debug their actions, and to evaluate the whole process while referencing the entire scenario's goal. As seen on Fig. 3b, Sara stimulated her students' evaluation in minutes 3, 8–9, and again near the scenario's end in the 10th minute. To conclude, Sara's SRT pattern was compatible with a high level of implementation of the cyclical three-phase self-regulation model referencing the whole range of metacognitive elements in a balanced sequence that intertwined with the motivation elements (Zimmerman 2008).

In contrast, Gail, who experienced the top-down open-minded generic-prompts condition *("Stop and reflect," "Think about")*, demonstrated a thinking pattern focusing mainly on guiding her peer students regarding the metacognitive forethought elements. Thus, she first started with information management elements and then moved to the planning elements (58 % of her events as shown in the oval on Fig. 3a). Furthermore, her real-time teaching scenario combined fewer of the monitoring and evaluation elements (28 % of the events) and mostly ignored motivational aspects (only 7 % of the events), which are essential features in holistic self-regulation models (Pintrich 2000; Zimmerman 2008).

As seen in Table 6 and Fig. 3a, the temporal pattern of Gail's SRT elements shows her focus on the forethought phase of the SRT along the 10 min of the scenario. Her implementation of regulatory elements corresponding to the action and evaluation phases occurred fairly infrequently, with large time intervals in between: monitoring in the 2nd and 9th minutes, debugging only in the 5th minute, and evaluation only in the last minute of the scenario. Moreover, these elements only achieved a quality score of 2, indicating mainly an implicit level of SRT with only partial justification. To conclude, Gail's SRT pattern showed only weak correspondence with the original three-phase cyclical self-regulation model. Her real-time teaching revealed an

unbalanced sequence and low level of forethought, action, and evaluation elements, with minimal blending of motivational elements (Zimmerman 2008).

SRT-oriented strategic instruction and sequential/temporal SRT patterns in lesson designs, by case Table 7 presents an in-depth analysis of the two preservice teachers' lesson designs written at the end of the intervention, examining their posttest SRT-oriented strategic instruction (external/internal regulation) and pattern of SRT element usage. Regarding SRT-oriented strategic instruction along the external to internal regulation continuum, 64 % of Sara's utterances were scored as oriented to students' internal regulation and justified by overt "why" justifications (score of 3, shown in bold on Table 7), and another 36 % of her utterances scored 2 (intermediate regulation with partial justification), yielding a high overall mean SRT quality of 2.63. Similarly, 56 % of Gail's utterances contained the highest level of internal regulation with explicit "why" justifications (shown in bold on Table 7) and another 44 % scored 2 (intermediate regulation), yielding a similarly high overall mean SRT quality of 2.56. Thus, in their non-prompted written SRT-oriented lesson design, both preservice teachers revealed a similar orientation toward proactively promoting high-school students' internal regulation.

The sequential pattern of SRT elements in Sara's lesson design manifested a balanced pattern that combined metacognitive and motivational SRT elements: 35 % referring to forethought (planning and information management), 40 % referring to metacognitive regulatory elements (monitoring, debugging, and evaluation), and 25 % referring to motivation. Thus, these data from Sara, who was exposed to the specific-prompts condition, again yielded a pattern compatible with the entire three-phase cyclical self-regulation model referencing both metacognition and motivation (Zimmerman 2008). Indeed, Sara's final statement in her lesson design (Utterance #11) explicitly summarized the lesson from a cyclical SRL perspective (Zimmerman 2000) for her students, by detailing the three metacognitive elements – planning, monitoring, evaluation – and a motivational element – self-efficacy. She wrote: "*It's extremely important that I say* [Planning] *2–3 sentences of summation* [Evaluation] *in order to get students' attention back* [Monitoring] *and to foster understanding by all the students* [Self-efficacy]." Raising understanding is a kind of self-efficacy awareness aroused by the student. Modeling is a prominent strategy in the specific-prompts condition that explicitly trained Sara to stimulate students' internal regulation.

In contrast, Gail's lesson design demonstrated an unbalanced pattern of SRT elements, focusing mainly (60 %) on the forethought phase (planning and information management) and less (19 %) on the in-action regulatory elements (monitoring) and evaluation phases or on motivation (20 %). At the end of her lesson design, Gail decided to summarize the lesson with an SRT-oriented strategy corresponding with her training in the generic-prompts condition. She asked open questions to elicit discussion, like: "*What do you think about smoking now? Have you changed your mind? Explain why.*" These questions stimulate students' internal regulation but do not model explicit use of SRT elements.

To summarize, Sara's and Gail's far-transfer lesson designs revealed a similar level of SRT strategic instruction oriented to secondary students' internal regulation (Sara: $M = 2.63$; Gail: $M = 2.56$); yet, they modeled SRT differently. Sara used specific elements whereas Gail used open-minded questions, corresponding to their differing training prompts. Furthermore, these two preservice teachers' lesson designs

Table 7 Two case illustrations of lesson designing: transcripts of Sara's (7a) and Gail's (7b) SRT in the posttest lesson design

a

Utterance no.	Excerpts from Sara's posttest lesson design on smoking (specific-prompts condition)	SRT sequential pattern	SRT-oriented strategic instruction level (Score) *[Justification]*
1	…Because smoking is extremely important, *I would use (P)* a jigsaw puzzle classroom activity to discuss *goals (P)* and to *engage* students with the topic (*IV*).	*P + IV*	Internal regulation (3) *[Why]*
2	I would ask *the question (IM)* how many people in Israel, in their opinion, are sick with lung cancer… After students guess, *I would say the exact number (D).*	*IM + D*	Intermediate regulation (2) *[What, How]*
3	Another *introduction* could be: *asking* students *(P)* to bring a *cigarette box* to class *(IM)*… and then to discuss why people smoke if it damages …?	*P + IM*	Internal regulation (3) *[Why]*
4	*At this stage (P),* I would remind the class that today we are learning about smoking…	*P*	Intermediate regulation (2) *[What, How]*
5	… to gain understanding each group will consist of 4–5 students, who will have *to prepare (IV)* and *compare (M)* a kind of initiative or advertisement for smoking prevention.	*M + IV*	Internal regulation (3) *[Why]*
6	Introducing these ideas to the whole class will prevent *misunderstandings.. (D)*.	*D*	Intermediate regulation (2) *[What, How]*
7	The flashcards could help each student to *check his or her actions (M)*... and guide them in how to do the *group work (SE)*... in the smoking unit.	*M + SE*	Internal regulation (3) *[Why]*
8	At the end of the lesson, each group will introduce its initiative and *summarize* the work *(E)* to the class to help understanding.	*E*	Internal regulation (3) *[Why]*
9	I will *summarize (E)* the work done in class with a handout that includes all the taught material.	*E*	Intermediate regulation (2) *[What, How]*
10	In case *I have time (P)*, it would be important to *organize a mock trial (IV)* in which 3 groups (prosecution, defense, and judges) introduce their own planning (P) and reasons in favor or against the use of cigarettes.	*P + IV*	Internal regulation (3) *[Why]*
11	It's extremely important that *I say 2–3 (P)* sentences of *summation (E) in order to get students' attention back (M)* and to foster understanding by all the *students (SE).*	*P+ E + M + SE*	Internal regulation (3) *[Why]*

Table 7 (continued)

b

Utterance no.	Excerpts from Gail's posttest lesson design on smoking (generic-prompts condition)	SRT sequential pattern	SRT-oriented strategic instruction level (Score) *[Justification]*
1	The lesson will *focus (P)* on *awareness (M)* among youth about the negative effects of smoking.	*P + M*	Intermediate regulation (2) *[What, How]*
2	[*Introduction on smoking: 5 min*] *(P)*. The students will *ask questions (IM)* to understand research on smoking, and will express their *opinions and feelings (SE)* about this phenomenon.	*P + IM + SE*	Internal regulation (3) *[Why]*
3	*Does anyone know a smoker (IV)? How can it influence his/her life? (IM)*	*IV+ IM*	Intermediate regulation (2) *[What, How]*
4	[*Activity: 30 min*] Divide the class into three group, each of 10 students, who will discuss *(P)* the topic and present the main points in the entire class.	*P*	Internal regulation (3) *[Why]*
5	Group A will be asked to *dramatize* smoking *(IV)*. They will put on a show of *5 min' length (P).*	*P + IV*	Intermediate regulation (2) *[What, How]*
6	Group B will analyze a research study, by *searching (IM)* in the computer lab for research and articles that treat this issue from another point of view. The *goal (P)* is for them to assimilate computer usage as a source of knowledge.	*IM + P*	Internal regulation (3) *[Why]*
7	Group C will make a *poster (IM)* about smoking among young students.	*IM*	Intermediate regulation (2) *[What, How]*
8	*Final work (E)* will be presented in class and discussed in small groups to gain different points of view.	*E*	Internal regulation (3) *[Why]*
9	*[End of topic] (E)*. I will ask questions like: "What do you think about smoking now?" Or "Have you changed your mind? Explain why?"	*E*	Internal regulation (3) *[Why]*

SRT = self-regulating teaching (teacher role). SRT is based on five metacognitive elements (planning = P, information management = IM, monitoring = M, debugging = D, and evaluation = E) and two motivational elements (interest and value = IV and self-efficacy = SE)

manifested different patterns for using the cyclical SRT phases, which resembled the patterns they used in their actual teaching.

Discussion

As seen, the current findings supported both study assumptions. The group differences that emerged from our study highlighted the differential effects of the reflective prompting conditions – generic vs. specific – on the development of preservice teachers' dual self-regulation roles. The case illustrations contributed to a more in-depth understanding of the dynamic, complex series of reflective events unfolding within this authentic preservice setting. We discuss the findings in correspondence with the two research questions.

Generic vs. specific prompts: benefits for dual self-regulation roles

Overall, some group differences emerged in favor of the specific-prompts condition from three of these study measures that tapped dual roles: two declarative measures (SRL self-awareness and skills for noticing students' SRL) and one process measure (SRT-oriented actual teaching). No group differences emerged between the two conditions for the other process measure, SRT-oriented lesson design.

Our findings regarding preservice teachers' self-reported learner role revealed that although the teachers in both prompting conditions began the intervention with a similar level of self-awareness about their own SRL, at the end of the study the specific-prompts condition outperformed the generic-prompts condition on three self-reported SRL elements, concerning information management, monitoring, and debugging. In the other measure tapping the learner role, the preservice teachers who had been exposed to the specific-prompts condition were able to more accurately notice videotaped students' SRL than their peer teachers in the generic-prompts condition at the end of the study, not only regarding students' planning and evaluation elements (referring respectively to the forethought and reflection self-regulation phases) but also regarding both motivational elements in the videotaped students. Likewise, the real-time teaching measure indicated that participants' teacher role benefited more from the specific-prompts condition than from the generic-prompts condition. While briefly teaching their peers, the preservice teachers' in the specific-prompts condition used six out of the seven metacognitive and motivational SRT elements (all except debugging) in an explicit manner that specified "why" justifications for their decisions and achieved the highest quality scores for promoting peers' SRL. The real-time teaching of preservice teachers in the generic-prompts condition did not seem to derive a similar level of benefit from their prompts; exposure to these generic types of prompts during the course succeeded only in raising preservice teachers' SRL self-awareness of their own interest and value and self-efficacy at the posttest – the learner role.

As such, we can conclude that preservice teachers who had experienced the specific-prompts condition benefited in both of their dual self-regulation roles, along all three cyclical phases and across almost all the self-regulatory elements concerning metacognition and motivation. These findings are important in light of previous outcomes (Spruce and Bol 2014) showing that teachers demonstrated gaps between their SRL knowledge and their SRT practice, predominantly around goal-setting for a task and evaluation after a learning

event. In particular, important differences between the generic-prompts and specific-prompts conditions were manifested in preservice teachers' SRT during actual teaching. Successful use of SRT during real-time teaching activity is a complex set of skills that requires preservice teachers to simultaneously bridge between their learner role (SRL) and their teacher role (SRT) to proactively promote students' SRL (Kramarski 2016; Kramarski and Revach 2009; Peeters et al. 2013; Randi 2004).

These significant differences may be explained by the nature of the reflective prompts to which each group of preservice teachers was exposed. The generic-prompts condition stimulated preservice teachers' analyses and discussions of videotaped (SRL) and live teaching scenarios (SRT) by encouraging open reflection directed toward autonomous thinking, evaluating one's learning and instruction, and explanations of reasoning. Yet, these stimuli appeared to be too vague to enable preservice teachers to apply the entire gamut of SRL elements to their own practice of SRT. Our findings support previous conclusions that learners' reflection is best improved when they have a clear understanding of what they are explicitly being asked to reflect upon (Bol et al. 2012; Davis and Linn 2000; Kaufman et al. 2008; Kistner et al. 2010).

In contrast, the specific-prompts condition systematically focused preservice teachers' analyses and discussions of the videotaped and live teaching scenarios, by detailing the steps of noticing, exemplifying, improving, and explaining SRL/SRT elements, while looking back and looking ahead at the teaching/learning experience. Such prompts helped preservice teachers by explicitly modeling and internalizing the multiphase self-regulation cycle for integration into practice (Kramarski 2016; Michalsky and Kramarski 2015). Our findings favoring the specific-prompts condition for SRL and SRT support Schön's (1983) argument about the relationship between accurate seeing (noticing) and knowing: As practitioners bring their specific repertoire of experiences, examples, understandings, and actions gained by the intervention, they are able to "see" and make sense of new situations. Also, our specific-prompts condition's advantages substantiate other researchers' conclusions that novice learners benefit from specific prompts, which stimulate a clear understanding of what to reflect upon and which guide novices to give evidence for "why" in order to justify reasoning and accuracy (Bol et al. 2012; Davis 2003; Ifenthaler 2012; Kramarski and Michalsky 2010; McNeill and Krajcik 2008; Michalsky and Kramarski 2015; Schoenfeld 2010). The current outcomes expand on previous research that pinpointed specific prompts' benefit for developing preservice teachers' reflective skills by comparing these effects to a generic-prompts condition rather than to a control condition as previously (Davis 2006; Kaufman et al. 2008; Kohen and Kramarski 2012). Furthermore, our findings expand on prior research that focused on the effects of specific prompts that were oriented to content (Bol et al. 2012) or to pedagogical knowledge (Michalsky and Kramarski 2015) but not to preservice teachers' dual roles simultaneously, which is a unique contribution of the current study.

Transfer of prompt-stimulated gains in dual roles to non-prompted SRT-oriented lesson designs

Interestingly, despite the two prompting conditions' differences on SRL and SRT measures, favoring the specific-prompts condition, the far-transfer task (lesson designs directed to an authentic classroom context) did not reveal such an effect for prompting condition. Lesson designing is a high-order thinking skill in which preservice teachers are asked to mentally

visualize a particular classroom (Seidel et al. 2013) and then to integrate strategic instruction based on what they learned in the course but without exposure to any kind of prompts. Both prompting conditions appeared to be beneficial for preservice teachers in designing a lesson oriented to SRT that would challenge students to exert more control (internal regulation) over the pace and course of their own learning (Kohen and Kramarski 2012; van Beek et al. 2014).

The success of participants in the generic-prompts condition on the transfer task supports previous studies indicating that generic prompts are an important aid for developing metacognitive structures while solving problems; at the same time, generic prompts give individuals a certain extent of autonomy to self-regulate their problem-solving that can be easily linked and transferred to demands for internal regulation and domain knowledge (Aleven et al. 2006; Davis 2003; Ifenthaler 2012; Kramarski and Michalsky 2009; Kramarski et al. 2013a).

On the other hand, the emphasis on explicit thinking in the bottom-up reflective specific-prompts condition (noticing, exemplifying, improving, and explaining while looking back and ahead) appeared to enable preservice teachers to walk through specific self-regulation examples in both roles (SRL, SRT). By underscoring local processes, the specific-prompts condition thus appeared to lead to improved mental models over time by making self-regulation elements visible – which may increase transfer to lesson designs oriented to SRT (Davis 2003; Hattie and Yates 2014; Salomon and Perkins 1989). Mental models are representations of situations and interrelations based on prior knowledge that can be easily applied to novel transfer tasks in a new context (Hattie and Timperley 2007; Kramarski et al. 2013a; Krauskopf et al. 2012; Saldana 2015).

If that is the case, then why didn't specific prompts surpass generic prompts in the transfer task? This raises questions that cannot be answered from our study. One explanation might be that the long duration (1.5 h) given to design the science lesson gave ample space to preservice teachers in the generic-prompts condition to autonomously elicit justified ("why") internally regulating strategic instruction for the targeted authentic students' learning and thereby to link the two roles of self-regulation attained in the course (SRL and SRT), thus narrowing the gap with the specific-prompts condition.

Another explanation might be that both prompting conditions enabled preservice teachers to successfully apply the dual self-regulation knowledge that they had attained during training, albeit via different thinking paths, moving from generic top-down prompting for SRL/SRT to specific bottom-up prompting and vice versa. Importantly, the finding that both prompting types facilitated preservice teachers' essential skill of SRT-oriented lesson design expands prior research on school students, which showed that knowledge can be transferred to a new topic under different thinking paths (Kramarski et al. 2013b; Salomon and Perkins 1989), such as the low-road path of concrete thinking or high-road path of abstract thinking. Future studies should utilize further empirical methods that might be appropriate to uncover those processes as suggested in the next section.

Patterns of SRT elements and processes in two case illustrations

Our in-depth pattern analysis for two case studies contributed additional perspectives to understanding the dynamic processes by which Sara's and Gail's teaching practices unfolded over different SRT phases under the two prompting conditions. Our novel examination of the teacher role explored these two preservice teachers' incidence (presence), quality

(explicitness), sequence, and timing of SRT elements in their actual teaching, and their externally/internally regulating SRT-oriented strategic instruction in their lesson designs.

Although the cycle of self-regulation features prominently in SRL theories (Zimmerman 2008), we found that Sara and Gail each implemented this model differently. Generally, having experienced the specific-prompts condition, Sara's balanced sequence blending metacognitive and motivational SRT elements – both in her real-time teaching and her lesson designing – more closely resembled the theoretical cyclical SRL model compared to Gail's unbalanced sequence following her exposure to the generic-prompts condition.

However, these case studies provide only micro-level evidences on the benefits of the specific-prompts condition, which cannot be generalized without further investigation.

These data call for further research about SRT on the macro level to learn about the dynamic effects on SRT among a larger group of preservice teachers exposed to specific-prompts and generic-prompts conditions (Cleary et al. 2012). Future research should elaborate on the sequential and temporal characteristics of SRT, focusing on *when* actions and sequences take place and *how* they act over the timeline of the lesson. Researchers' expansion to additional case studies exposed to each prompting condition (generic and specific) will help deepen understanding about the two kinds of prompts' effects on preservice teachers' dual SRL roles (as learners and as teachers), in particular with an eye to exploring their implications for different types of authentic learners in heterogeneous classes (Kramarski et al. 2013a).

Practical implications, limitations, and future research

The outcomes of this study make an important contribution to the literature on preservice teachers' abilities to increase their self-regulation roles as learners and teachers. The current findings underscored that teachers, and preservice teachers in particular, are always learners too, which requires them to constantly bridge the dual self-regulation roles in teaching and in learning (Buzza and Allinotte 2013; Kramarski and Michalsky 2009, 2010; Peeters et al. 2013; Perry et al. 2008). Our study is a starting point for testing this claim by integrating both of the dual self-regulation roles into a single research design with two kinds of prompts that have previously been investigated mostly among school students with inconsistent findings about effectiveness.

The current study findings contribute uniquely to theoretical and methodological aspects, practical implications, and future research for developing reflective practitioners among teachers, whether preservice or inservice. Theoretically, the current findings add validation to SRL models (Schraw 1998; Zimmerman 2008) by implementing these metacognitive and motivational elements in the context of dual self-regulation roles, which have previously received insufficient empirical investigation. Our findings also lend support to prior calls recommending that SRL/SRT should become a habit of mind for preservice teachers' professionalism, whereby a cyclical process of metacognitive and motivational elements becomes part of teachers' thinking and action (Kramarski 2016; Michalsky and Kramarski 2015; Peeters et al. 2013; Randi and Corno 2000).

Second, methodologically, our study's outcomes contributed a set of detailed process (event) and product (declarative) measurement tools. The declarative (product) measures focused on self-awareness of SRL knowledge (Schraw and Dennison 1994) and skills for noticing authentic videotaped students' SRL (e.g., Craig et al. 2009; Muldner et al. 2013; Santagata and Guarino 2011). Process self-regulation measures typically explain the variance

in SRL and SRT events during learning and teaching (Azevedo 2014; Cleary et al. 2012; Molenaar and Järvelä 2014; Zimmerman 2008), as also measured by our pattern data analyses for case illustrations assessing SRT in actual teaching and lesson design (far-transfer).

Third, practically, in the current study we offer a professional program that guides the acquisition, activation, and application of preservice teachers' self-regulation as learners or as teachers who proactively promote self-regulation in students. Specifically, we propose a clear, useful, and operational program for making the concept of self-regulation a part of teachers' critical reflective discussion. This program describes how specific prompts for reflecting back and ahead while accurately noticing, exemplifying, improving, and explaining learning/teaching events over time can still lead to more generic principles by creating mental self-regulation models that may promote teachers' dual self-regulation roles (Hattie and Timperley 2007; Krauskopf et al. 2012).

Despite this study's potential contributions, several limitations of the study deserve consideration. In this study, we focused on preservice teachers in one university during their training under laboratory conditions using a pool of ready-made video clips of authentic classroom scenarios. Only a one-time 10-min assessment of actual teaching experiences and one type of far-transfer task (lesson designs) were utilized. Although the real-time teaching measure and lesson-design task were analyzed both for the group comparisons and for in more detail for case-study comparisons, these teaching experiences should be expanded in future research to validate the current conclusions. Another limitation is that we only measured preservice teachers' own SRL indirectly, via preservice teachers' self-reports about awareness of their own SRL strategy use and via a measure of preservice teachers' skills for noticing videotaped students' SRL. A better, more direct measure of SRL improvement could include observing participants during SRL via some form of trace methodology as we performed to measure SRT from the videotaped real-time teaching.

We recommend replication of this study by focusing on a longer duration of process assessment (e.g., a full videotaped lesson) that would help uncover the sequential and temporal SRT characteristics exhibited during various activities. In addition, considering the aforementioned limitation in generalizability from the micro-level evidence (case studies) to the macro level (of the total sample), these processes should be analyzed from the larger group or more cases selected from each condition (generic-prompts and specific-prompts), followed by some reflective interview questions related to preservice teachers' opinions about their dual SRL and SRT roles. Such elaborated analysis would strengthen triangulation of findings and would enhance the credibility of results to detect if the who sample's pattern of results differs from that of the case studies.

Future researchers would do well to assess transfer effects on several tasks, including some well-structured and some ill-structured tasks, while testing immediately after the training as well as following up on lasting effects after a period of time in real-class situations. Finally, based on the promising effects of the generic-prompts condition on the transfer task, another option would be to investigate a third condition that uses both generic and specific prompts. Preservice teachers might begin by using specific prompts to ensure that no important SRL elements or processes were skipped during instructional practice, and then these prompts could be gradually withdrawn and replaced with some generic prompting method like "*Think about, evaluate, and explain*"). This suggestion follows Nückles et al. (2009), who showed the benefits of a fading training condition working with metacognitive prompts, which give learners time to internalize and practice autonomous learning habits that are prerequisites for

SRL/SRT processes, and then to again receive some support for maintaining the gained intervention effects (van Beek et al. 2014).

Conclusion

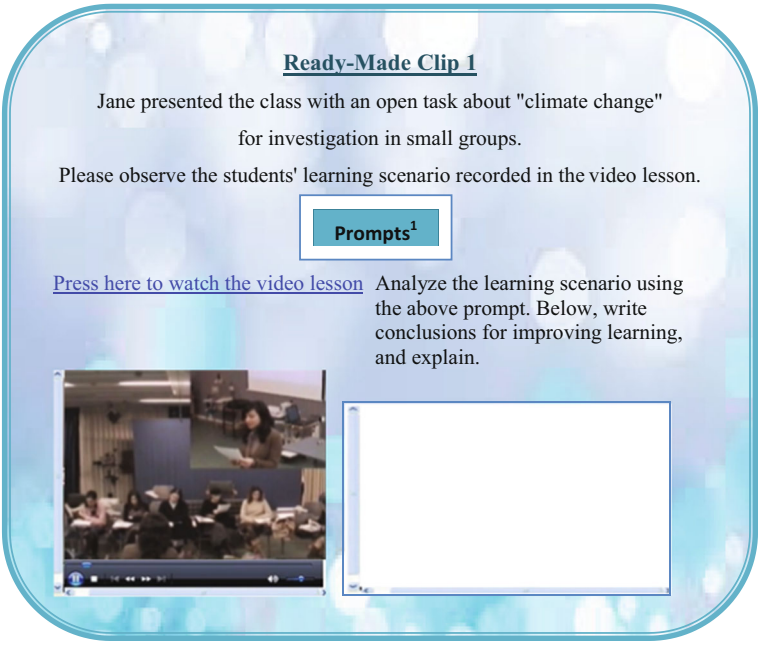
Recalling the overall importance of self-regulation in learning and teaching to address 21st-century global challenges, we illustrate the contribution of generic vs. specific prompts in promoting preservice teachers' dual self-regulation roles as learners (SRL) and as teachers (SRT). A crucial future direction for this line of research is to link teachers' dual SRL and SRT to students' SRL and content acquisition (Kramarski 2016).

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest

Appendix

Sample Snapshot of Prompted Interface with Ready-Made Authentic Clip for Noticing Videotaped Authentic Students' Self-Regulated Learning (SRL)



[1] One of the following two sets of prompts appeared: **Generic prompts**: *Stop the recording every few minutes, and give your opinion regarding the learning effectiveness of the segment you watched.* **Specific prompts**: *What SRL elements do you notice in students' engagement in learning? How can learning be improved? And why? Explain and give examples.*

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