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Research paper

Professional development in self-regulated learning: Shifts and variations in teacher outcomes and approaches to implementation

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HIGHLIGHTS

- Professional development (PD) workshop enhanced self-regulated learning (SRL) outcomes in teachers.
- Not all teachers exhibit the same level of growth following the PD workshop.
- Level of teacher SRL skill following PD relates to attitudes and approaches to SRL implementation.

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ABSTRACT

The purpose of this explanatory, sequential mixed methods study was to examine pretest - posttest changes in high school teachers' knowledge of self-regulated learning (SRL) and their self-efficacy and skills in applying SRL following a professional development (PD) workshop. Teacher interviews and qualitative analyses were used to assess differences in teachers' attitudes, perceptions, and experiences when implementing SRL. In general, the 19 teachers showed large gains across all measures at posttest. Teachers who displayed advanced SRL skills following the PD exhibited more flexible, responsive, and positive perspectives on implementing SRL in the classroom than teachers with emerging SRL skills.

1. Introduction

The role of secondary school teachers is challenging and complex. In addition to effectively managing classroom activities, student behaviors, and other situational stressors, teachers are expected to provide high-quality instruction. For science teachers, the Next Generation Science Standards (NGSS; Achieve, 2013) represents an important initiative for guiding high-quality instruction and promoting student competencies. Importantly, by focusing on science and engineering competencies, or practices that cut across all science content areas like data practices and computational thinking (CT), NGSS is foundational to helping students think more like scientists; that is, to become more self-directed, reflective, and problem-solving focused (NSTA, 2014).

Across many academic contexts, researchers have begun to recognize the importance of student self-regulated learning (SRL), a process through which students proactively manage and control their thinking, actions, and environments to attain personal goals. Specifically, in science, researchers have underscored how SRL processes are closely intertwined with NGSS standards (Peters-Burton, Cleary, & Kitsantas, 2018; Peters-Burton et al., 2020), epistemic thinking in science (Peters & Kitsantas, 2010; Schraw et al., 2006), 21st-century skills (Stehle & Peters-Burton, 2019), and curriculum design (Peters-Burton & Botov, 2017). For example, Peters-Burton et al. (2020) outlined a crosswalk explaining how CT and SRL skills are closely intertwined and how they can, individually or collectively, optimize data practice skills during a science investigation.

Despite this emerging emphasis on student SRL skills and the growing recognition among educators regarding the value of enhancing such skills, teachers often do not feel adequately

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prepared or supported to incorporate SRL into their teaching (Cleary et al., 2010; Spruce & Bol, 2015). This "SRL application gap" is particularly problematic for teachers working in secondary school settings, given that these contexts typically involve higher demands and expectations for student self-sufficiency and autonomy. This gap has prompted researchers to develop and evaluate the effectiveness of SRL-promoting professional development (PD) initiatives with teachers. In general, research shows that SRL PD activities can have a positive influence on teacher knowledge and skills and can help teachers focus on student proficiency of science and engineering practices (Kramarski et al., 2013; Peters-Burton et al., 2020; Peters-Burton et al., online first; Spruce & Bol, 2015). However, there are still many unresolved issues regarding the implementation and evaluation of SRL PD programming (Kramarski et al., 2013), such as examining teacher outcomes more comprehensively and more fully understanding differences in teacher perceptions and reactions to implementing SRL processes in authentic contexts.

Borrowing from theoretical and conceptual frameworks of PD (Darling-Hammond et al., 2017; Desimone, 2009; Guskey, 2002) as well as social-cognitive models of SRL (Zimmerman, 2000), the current study utilized an explanatory, sequential mixed methods design to evaluate the effects of a comprehensive SRL PD workshop on teacher outcomes. In addition to examining pretest – posttest changes following the workshop, the current study utilized thematic analysis procedures to examine differences in teacher attitudes, perceptions, and experiences when applying SRL to their lessons.

2. Overview of SRL and its importance in school contexts

SRL is conceptualized as a contextualized, cyclical feedback process that individuals use to attain personal goals (Panadero, 2017). Although different SRL models are discussed in the literature, most scholars view SRL as a dynamic, fluid process that integrates multiple processes, such as goal setting, self-monitoring, strategy use, and self-reflection (Panadero, 2017; Schunk & Greene, 2018). From a social-cognitive perspective, Zimmerman (2002) describes SRL as a cyclical loop encompassing three phases: forethought, performance, and self-reflection. In forethought, students set goals and formulate plans for approaching a problem. These processes set the stage for learning engagement. During performance, students enact their strategic plans and seek to gather information about goal progress through self-monitoring or from feedback from others. Students use this performance-related information to self-reflect; that is, to evaluate their level of success, the reasons for that success, and the best approach for making changes or improvement in the future. This cyclical model served as the foundation for the SRL content delivered to the teachers as part of the PD training.

Another important social-cognitive model details the nature of SRL development across four complementary and sequenced levels: *observation*, *emulation*, *self-control*, and *self-regulation* (Cleary et al., 2017; Zimmerman, 2000). From this perspective, in the early stages of learning, individuals will often learn by observing others (i.e., observation) and practicing the modeled skills or behaviors in a structured context (i.e., emulation). It is during the emulation level that students receive feedback or other supports to enhance skill development. In the next level, self-control, individuals will take on greater initiative in structuring their practice sessions, although they still can access social support from others. In the final level, self-regulation, individuals display proficiency in planning, monitoring, and reflecting with minimal guidance from others. At this level, they are proficient in adapting their behaviors as needed to reach desired performance levels. The SRL PD workshop administered in the current study emphasized observation, emulation, and some aspects of self-control.

Importantly, SRL skills and processes have been shown to predict academic achievement (Cleary et al., 2017; Cooper & Corpus, 2009; Dignath & Büttner, 2008), and often represent a central component of academic interventions (Harris & Graham, 2009; Montague et al., 2014). Teachers have also expressed positive perceptions about utilizing SRL strategies in their classrooms (Dignath-van Ewijk & van der Werf, 2012; Spruce & Bol, 2015), with particular emphasis on the cognitive and motivational strategies (Dignath & Büttner, 2018; Schraw et al., 2006). However, given the increasing complexity and demands of high school along with emergent trends in instruction (e.g., online learning), school districts and teachers have a desire for more guidance and feedback about how to optimally influence student SRL (Cleary & Zimmerman, 2006; Coalition for Psychology in Schools and Education, 2006).

3. SRL professional development and coaching

To enhance SRL skills among school-aged children, researchers have often focused on the development and implementation of SRL intervention programs (Cleary et al., 2017; Montague et al., 2014). Academic-focused SRL interventions have been developed in the areas of reading (Tonks & Taboada, 2011), mathematics (Montague et al., 2014), writing (Harris & Graham, 2009) science (Cleary et al., 2017), and social studies (Greene et al., 2010). While providing students with direct SRL intervention supports is invaluable, researchers have also recognized the importance of teacher PD programming and initiatives to infuse SRL in the classroom. This increasing focus on PD programming is due, in part, to a growing gap between teachers' desire to infuse SRL principles into their teaching and the limited experiences and direct supports they typically receive for implementing SRL principles in their classrooms (Kremer-Hayon & Tillema, 1999; Lau, 2012; Pauli et al., 2007).

4. The nature of SRL PD

Several empirical-based practices and theoretical frameworks have been developed for teacher PD that collectively emphasize key instructional principles including context knowledge, active learning, and collaboration (Darling-Hammond et al., 2017; Desimone, 2009; Guskey, 2002). In 2017, Darling-Hammond and colleagues from the Learning Policy Institute published a research report about positive effects of PD on teachers' instructional practices and student outcomes. Based on this review of 35 PD programs, the authors identified seven characteristics of high-quality PD. In short, effective PD: (a) is content-focused, (b) incorporates active learning, (c) supports collaboration, (d) uses models and modeling of effective practice, (e) provides coaching and expert support, (f) offers opportunities for feedback and reflection, and (g) is of sustained duration. Most effective PD programs include several, although not all, of these features. The PD utilized in the current study emphasized many of these features as well as the premise that teachers are more likely to engage in PD if they believe that it will lead to knowledge and skills that will contribute to their growth and student learning (see Guskey, 2002).

SRL PD programs often vary in terms of their duration and overall comprehensiveness. While some programs utilize a long-term, multi-component format (e.g., Perry et al., 2007), others can last only several weeks (Peters-Burton & Botov, 2017), or even as brief as a few hours (e.g., Allshouse, 2016). At one end of the spectrum, Perry et al. (2007) implemented a 4-year teacher education program in which 18 preservice teachers were grouped into

cohorts to develop practices that promote SRL in K-5 classrooms. With this sustained program structure and the recruitment of faculty associates who were experts in SRL, the authors created student-mentor dyads that facilitated opportunities for the pre-service teachers to observe and collaborate with mentors regarding lesson plans. Conversely, Allshouse (2016) implemented a short-term 3-h PD workshop to enhance middle and high school teachers' SRL knowledge, self-efficacy beliefs, and SRL application skills. Although brief, this latter workshop utilized several important PD practices, such as case study analyses, personal reflections, and collaborative activities among the teachers.

A more common PD format has involved a multi-day or multi-week format in which teachers meet for several hours on different days, typically over the course of a couple of months (e.g., Ganda & Boruchovitch, 2018; Kramarski & Michalsky, 2015; Peters-Burton & Botov, 2017). Ganda and Borouchovitch (2018) implemented a semester-long SRL program with 109 college students enrolled in a pedagogy course offered at a Brazilian public university. As part of a semester-long experience, the teachers had six, 2-h meetings (i.e., 12 h) involving oral presentations, theoretical tasks, and self-reflection activities. Other semester-long PD experiences have been more time-intensive. For example, Peters-Burton and Botov (2017) offered a 15-week (3 h per week) PD course to enhance K-5 elementary science specialists' understanding of using scientific inquiry to teach earth science. Teachers in this PD were involved in collaborative inquiry-oriented lesson analyses, exposed to exemplars from which they set goals and monitored progress, and engaged in creating their own earth science-specific lesson plans. Based on the successes of these previous studies in supporting the development of teachers' SRL skills, knowledge, and ability to apply it in the classroom, the current study supported teachers through an intensive week-long, 32-h SRL PD program.

5. Teacher effects and reactions following SRL PD

Despite the variability in SRL PD experiences and formatting, research tends to support their overall effectiveness. For example, in their long-term exploration into SRL PD with 18 preservice teachers, Perry and colleagues (2007) reported that the teachers had developed useful and complex tasks that effectively engaged students in SRL of reading and writing. Peters-Burton and Botov (2017) found that when SRL is immersed within an intensive PD program focused on science content, elementary science teachers' SRL skills (i.e., goal setting, self-monitoring, learning tactics) improved over time. Even in SRL studies involving a one-day PD workshop, teachers exhibited positive changes. Allshouse (2016), who implemented a 3-h PD workshop, reported statistically significant pretest-posttest changes in nine middle and high school teachers' knowledge and application of SRL.

In addition to the positive effects of SRL PD, some research has linked teacher SRL knowledge and skills with their ability to conceptualize or implement SRL principles into their lesson plans or instruction (Buzza & Allinote, 2013; Dignath & Büttner, 2018; Dignath-van Ewijik and van der Werf, 2012; Peeters et al., 2014; Spruce & Bol, 2015). For example, in the context of a 9-month PD experience that integrated readings, discussions, and application activities, Buzza and Allinotte (2013) found a statistically significant relationship between pre-service teachers' self-reported SRL skills and their ability to observe instances of student SRL processes and behaviors exhibited in the classroom.

6. Purpose of the study

Consistent with emergent trends in embedding SRL processes in school contexts and classroom instruction, particularly in STEM content areas (Cleary et al., 2017; Delen et al., 2014; Kitsantas et al., 2011; Kramarski & Gutman, 2006), the current study had two broad goals. We sought to expand our knowledge about the benefits of intensive SRL PD workshops with high school science teachers, while also examining their experiences when attempting to apply SRL to classroom contexts.

In this study, we utilize a multi-method measurement approach to examine the effects of a weeklong 32-h SRL PD workshop on teacher knowledge, self-efficacy, and SRL conceptualization and application skills. In addition to using traditional teacher questionnaires, we utilized a free-response question format to assess teachers' knowledge and application skills and used a novel approach for assessing teachers' self-efficacy. That is, rather than assessing teacher self-efficacy in terms of a single aggregate score across multiple items, we evaluated a lower and upper bound of their efficacy for applying SRL with different groups of students (Method section). There is a paucity of research examining the effects of SRL PD within a more comprehensive, multi-method approach.

Furthermore, although the broader PD literature has underscored the key role that teacher perceptions and feelings have on their PD experiences (Bantwini, 2012; Gaines et al., 2019), few attempts have been made to directly examine and explore the reactions and perceptions of teachers regarding the barriers, challenges, and approaches to implementing SRL principles in authentic science contexts. This initiative is compelling given the strong connection between SRL principles, NGSS standards, and student success, and the need to consider the perspectives of teachers as key stakeholders in educational practices and policies. The following two research questions were addressed:

(1) Do high school science teachers show a statistically significant increase in their familiarity and knowledge with SRL, self-efficacy to apply SRL principles across students perceived as having different achievement levels, and their SRL conceptualization and application skills following an SRL PD workshop?
(2) What are the perceptions, attitudes, and experiences of science teachers regarding their attempts to infuse SRL principles in science lesson plans?

Based on results from prior research, we hypothesized that the teachers would show statistically significant gains across all outcomes. Given that the second research question was exploratory in nature, we did not propose specific hypotheses.

7. Method

7.1. Research design

In the PD literature, the use of mixed method designs is often emphasized given their utility for exploring nuances not captured by one method (i.e., qualitative or quantitative), and for providing a more holistic picture of a PD program (Onwuegbuzie et al., 2011; Parylo, 2012). We used a two-phase explanatory sequential mixed methods design (Fig. 1) to examine the effects of a one-week SRL PD experience conducted as part of a broader two-week PD training (June 2020−August 2020). In Phase I, we collected pretest and posttest survey data (i.e., familiarity and knowledge, self-efficacy, and application skills) for 19 science teachers via Qualtrics, an online survey platform. The SRL surveys were collected immediately before (pretest) and after (posttest) the PD workshop. Phase II involved conducting individual interviews with a subsample of the teachers approximately six months after the Phase I posttest. Phase I data was used to establish the two extreme subgroups of teachers

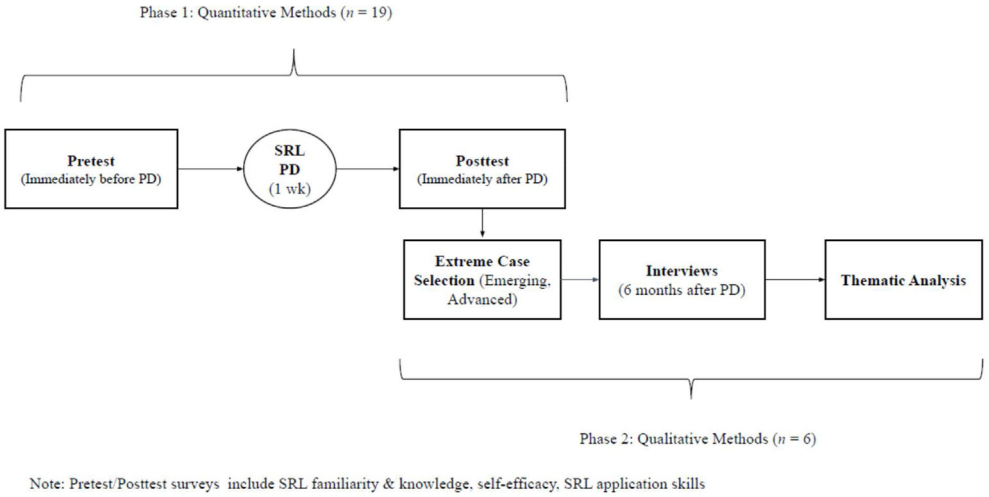

Fig. 1. Overview of two-phase explanatory sequential mixed model design.

(i.e., advanced or emerging). Thematic analyses were used to examine data from the teacher interviews for both subgroups to identify themes regarding their experiences and reactions to implementing SRL principles into their science lesson plans.

7.2. Setting and participants

All teachers who participated in this study were from a large, suburban school district in the Mid-Atlantic region of the United States. The teachers were recruited to participate in a larger project designed to examine the effects of using CT and SRL practices to promote data practices in high school science classrooms. Specifically, teachers who had previously worked with one of the authors during at least one PD program in the past seven years were recruited to participate. The recruitment procedures included an informational meeting with all interested teachers and one-on-one meetings with the teachers to discuss expectations for the PD. Nineteen teachers agreed to contribute to the project for three years.

The participating teachers were primarily female ($n = 15$; 79%) and White ($n = 17$; 89%). The average years of teaching experience was 10 years (SD = 6.94; range = 2–26 years). Approximately half of the teachers taught biology ($n = 9$, 47%); the remaining teachers taught physics, chemistry, or earth science (see Table 1 for additional demographics for the teachers). All 19 teachers participated in Phase I.

From this pool of teachers and based on Phase I posttest data, two extreme subgroups of teachers were identified. The two groups reflected teachers who exhibited either relatively strong SRL knowledge and skills at posttest (i.e., advanced SRL) or weaker SRL outcomes (i.e., emerging SRL). Six teachers who had previous training in SRL were eliminated from consideration for the extreme subgroups given our interest in comparing groups that were similar in terms of background and experience with SRL. The *advanced SRL group* included individuals who had SRL knowledge and application posttest composite scores of 3.5 or higher and fell within the top 25% of the sample regarding the number of SRL processes identified for posttest SRL application measure. Three teachers met these criteria. These teachers had four, five, and seven years of teaching experience, with two of them holding a master's degree. All three advanced teachers taught Advanced Placement and standard education courses, with two of the three teachers working at accelerated (i.e., high performing) schools.

Table 1
Demographic information of phase one participating sample (n = 19).

Variable	n (%)
Gender	
Male	15 (79%)
Female	4 (21%)
Ethnicity	
White	17 (89%)
Asian	2 (11%)
Age	
18-24	1 (5%)
25-44	14 (74%)
45-64	4 (21%)
Content area	
Biology	9 (47%)
Physics	4 (21%)
Earth science	2 (11%)
Chemistry	4 (21%)
Grade Level	
9th	12 (63%)
10th	13 (68%)
11th	11 (58%)
12th	11 (58%)
Course Level	
General	13 (68%)
Honors	15 (79%)
AP	14 (74%)
Dual enrollment	5 (26%)
Teaching experience	
Range	2–26
Mean (SD)	10.45 (6.94)

The *emerging SRL group* included individuals who had SRL knowledge and application posttest composite scores of 2.5 or lower, and fell within the bottom 25% of the sample regarding the number of SRL processes for the posttest application measure. Three teachers met these criteria. Similar to the advanced group, all of these teachers possessed a master's degree and expressed similar years of teaching experience (four to six years), except for one teacher who had 25 years of experience. Two of the three teachers taught Advanced Placement and standard education classes, while the third teacher only taught standard classes. None of the three teachers taught at accelerated schools.

8. Data collection instruments

8.1. Teacher familiarity of SRL

Teacher familiarity of SRL was assessed using an 11-item measure created by the researchers. This measure used a 3-point Likert scale (1 = *not familiar*, 2 = *somewhat familiar*, and 3 = *very familiar*), with the question stem, "How familiar are you with […]". The items assessed teachers' familiarity with SRL and its specific components (i.e., goal setting, task analysis, motivation, time management, organization, help-seeking, anxiety control, self-monitoring, self-reflection, and adapting behaviors). A sample item was "How familiar are you with student goal-setting?" High Cronbach's alpha reliability coefficients were found for pre-PD scores (α = .96) and post-PD scores (α = 0.92).

8.2. Teacher efficacy for applying SRL

Teachers' self-efficacy beliefs for infusing SRL into their lesson plans were assessed using a 10-item measure with a Likert scale ranging from 0 (*certain cannot do at all*) to 100 (*highly certain can do*). The scale ranged in 10-unit intervals from 0 to 100 (i.e., 0, 10, 20 etc.). These 10 items were developed based on Bandura's (2006) guidelines for developing self-efficacy measures and targeted different SRL processes (e.g., goal setting, self-monitoring, self-evaluation). A sample item was "To what extent can you develop lesson plans that enable students to successfully consider their goals when beginning a new assignment?" Unlike most self-efficacy measures, teachers were asked to rate their efficacy for each item under two conditions: (a) when working with students whom teachers perceived as academically at-risk (i.e., lower bound of efficacy), (b) when working with students whom teachers perceived as advanced or successful (i.e., upper bound of efficacy).

To establish content validity, a team of SRL experts created the initial items. Items were then field-tested with a sample of teachers similar in demographics to the participants. Feedback about the items and general comments about the instruments were reviewed by the team of experts and revisions were made prior to administration to the study participants. In this sample, the Cronbach's alpha reliability coefficients for these 10 items were high for pre-PD scores (lower, α = 0.97; upper, α = 0.95) and post-PD scores (lower, α = 0.98; upper, α = 0.91).

8.3. SRL knowledge

Consistent with prior SRL research (Allshouse, 2016; Dignath-van Ewijik and van der Werf, 2012), one free-response question was used to examine teachers' conceptual understanding of SRL. The question was worded as follows: "How would you define and describe SRL? Provide as many details as you can using the space below." Teachers' written responses were evaluated using a rubric, which included a *quantity* and a *quality* component. The quantity component reflected the number of SRL processes included in the response. Acceptable and codable responses were based on sub-processes outlined in Zimmerman (2000) three-phase SRL cycle and sub-processes. Two graduate research assistants used the coding scheme to independently identify the number of SRL processes included in teacher responses. Each SRL process was given a code (1 = present, 0 = absent); the total number of processes identified were tallied for each teacher. To promote the trustworthiness and agreement of coding, frequent debriefing sessions were utilized in this study (Shenton, 2004). Coders met weekly to talk about their coding. Disagreements were discussed and resolved in consultation with a third researcher. Only the initial codes established by the two coders were utilized to establish the inter-rater agreement.

The quality component reflected teachers' conceptual understanding of SRL. The rubric consisted of three dimensions: *breadth* (i.e., number of SRL phases addressed in response), *depth* (i.e., level of details in terms of processes mentioned), and *iterative cycle* (i.e., reference to the iterative and cyclical nature of SRL). Each dimension was assessed using a 3-point scale (i.e., 1 = *beginning*, 2 = *developing*, 3 = *proficient*). The specific dimension scores were summed to generate a final quality score (i.e., *no basis* (3); *beginning* (4 or 5); *developing* (6 or 7); and *proficient* (8 or 9). A high level of inter-rater reliability was found between two coders based on the initial independent codes (Cohen's k = 0.89 for the pretest; Cohen's k = 0.94 for the posttest; McHugh, 2012). Disagreements between the initial coders were discussed and resolved through consensus building with a third researcher.

8.4. SRL application

Teachers' application of SRL was assessed using a hypothetical case vignette. The vignette depicted a struggling science student who displayed weak SRL skills and strategies. After reading the vignette, teachers were prompted to respond to the following question: "Create a list describing specific things you could do to help the student improve his self-regulated learning. If it helps to explain your thinking, you can also highlight sentences in the vignette and create a comment for your response related to that section of the vignette." Two versions of the vignette were created for pre- and post-PD assessment, respectively, to avoid testing threats to validity.

The quantity and quality application scores were calculated using a similar rubric and process with the SRL knowledge measure. The application rubric was distinct from the knowledge rubric given its focus on teachers' application of SRL principles to a case scenario. This rubric included three dimensions: *breadth* (i.e., number of SRL phases), *strategy explanation* (i.e., level of explanation of strategies), and *action plan* (i.e., level of robustness of action plan with justification). Similar to the knowledge question, each dimension was assessed using a 3-point scale, and the dimension scores were summed and categorized into one of the same four quality categories (i.e., no basis, beginning, developing, or proficient). Adequate inter-rater reliability was found between two coders based on their initial independent coding of the quality categories (Cohen's k = 0.79 for the pretest; Cohen's k = 0.72 for the posttest; McHugh, 2012). Disagreements among coders were discussed and resolved using consensus building.

8.5. Interviews with subgroups of teachers

Several of the authors conducted semi-structured, individual interviews with teachers from the advanced and emerging groups. These interviews targeted teacher perceptions, attitudes, and reactions to their initial attempts to embed SRL principles into their lesson plans during the school year following the SRL PD. Semi-structured interviews were used because they are a flexible technique for small-scale research that can provide rich details (Saldaña & Omasta, 2018; Savin-Baden & Major, 2013). Interviews were administered approximately five to six months after the PD to allow teachers enough time to begin implementing SRL principles into their lesson plans. The interview included the following general topics: demographics, motivations in PD, PD planning tools in data practices, CT, and SRL. In the present study, we focused only on teacher responses to the SRL-related questions, which targeted four key areas: (1) learning takeaways from the PD, (2) approaches to infusing SRL principles into lesson plans, (3) targeted/neglected SRL processes, and (4) perceived challenges. For each of these four

areas, the interviewers were permitted to ask follow-up and related questions to ensure clarity, detail, and robustness of the responses. The full interview was conducted via web-conferencing and lasted or approximately 45 min to 1 h. The interview was recorded for later transcription.

8.6. Description of the SRL PD program

The SRL PD workshop was included as part of a broader two-week Summer Institute. While Week 1 focused on CT and data practices, Week 2 involved the SRL PD workshop. The first three days of the SRL PD (approximately 16 h total) focused on providing definitions, examples, and illustrations of core SRL concepts and processes. The basic structure of these first three days entailed didactic-reflective-application activities across the forethought, performance, and self-reflection phase processes of SRL. It also involved modeling specific applications of SRL processes and included both large and small group activities.

The final two days of the SRL PD (approximately 16 h total) involved SRL expert-structured, guided practice opportunities and supervised independent lesson planning activities for the four science content areas (i.e., physics, chemistry, biology, and earth science). In the context of designing lesson plans for infusing CT with data practices, the teachers worked collaboratively with their respective content area colleagues to consider how best to support student SRL processes.

During the school year following the summer SRL PD, all teachers from a specific content area (e.g., physics, chemistry) met separately on a monthly basis with the research team. These one and a half hour sessions were designed to supplement and expand the summer PD. The first portion of these meetings typically involved sharing updates from the content-area teams or any other logistical information. The specific content area team was then encouraged to provide updates on their use of new lesson plans as well as their attempts to infuse CT and SRL principles into their lessons. Teachers who had taught a particular lesson were asked to share their successes or difficulties. Researchers and other teachers would share ideas and support for future implementation. These meetings were also used to gather feedback from teachers regarding their attempts to infuse CT and SRL into their science lessons. Approximately 20% of these meetings were devoted to SRL-related practices. Most teachers participated in five or six monthly sessions. The authors received approval from the relevant Institutional Review Boards to ensure the confidentiality and privacy of participants were protected and that all procedures used in the study were appropriate.

8.7. Data analyses

Paired sample t-tests were used to assess pretest-posttest changes across several quantitative measures (i.e., familiarity, self-efficacy, SRL knowledge, and SRL application), while a Wilcoxon Signed-Ranks test was used to assess pretest-posttest changes for the quality dimension of teacher knowledge and application due to the ordinal nature of the data (Woolson, 2007). An alpha level of 0.05 was used for these statistical tests unless otherwise noted.

Interviews were first transcribed by interviewers and uploaded to Dedoose (SocioCultural Research Consultants, 2021). An initial codebook with general themes was developed after one researcher read through the interview transcripts. Three trained graduate students then collectively coded the interview transcripts with the initial codebook while simultaneously revising and adding codes to the codebook. This iterative process ensured that the codes adequately represented the meaningful units of information conveyed in the interviews. Disagreements on the coding and the revision of the codebook were discussed and resolved in order to reach consensus. A thematic analysis approach was subsequently used to identify themes from coded segments (Braun & Clarke, 2006).

9. Results

9.1. Within-group changes for PD workshop participants

Descriptive statistics and correlations for all variables are reported in Table 2. To address our first research question, we examined within-group changes in the teachers' overall familiarity with and knowledge of SRL, their perceived self-efficacy to apply SRL to their lesson plans, and their SRL application skills. Consistent with our hypotheses, the teachers showed statistically significant and large gain scores across all measures. Paired *t*-test analysis showed that teachers' familiarity with SRL significantly increased following the PD, $t(16) = 3.26$, $p < .05$, $d = 0.79$. For SRL knowledge, two separate metrics were used: quantity and quality dimensions. The teachers exhibited a statistically significant increase in the quantity or number of SRL processes (e.g., goal-setting, cycle, reflection), $t(17) = 3.65$, $p < .05$, $d = 0.86$, as well as in the overall quality of their SRL understanding (i.e., breadth, depth, and iterative cycle), Wilcoxon Signed-Ranks test, $Z = 2.80$, $p < .05$, $r = 0.49$.

Additionally, paired sample t-tests showed large increases in teacher self-efficacy when working with students perceived as academically at-risk, $t(15) = 5.52$, $p < .05$, $d = 1.38$, and those perceived as high achieving, $t(15) = 4.27$, $p < .05$, $d = 1.07$. We also conducted an additional post-hoc analysis of the self-efficacy scores. We calculated the range of self-efficacy scores for each teacher (i.e., the difference between upper [high achieving] and lower bound [low achieving]) at both pretest and posttest. The objective was to identify whether the differences in efficacy judgments across student type got smaller after the PD workshop. Paired t-tests showed that the difference between the upper and lower bounds of efficacy showed a statistically significant decrease

Table 2
Descriptive statistics and spearman correlations across pretest and posttest measures.

	$M_1(SD_1)$	1	2	3	4	5	6	7	8	$M_2(SD_2)$
1.Self-efficacy lower	44.56 (12.54)	–	.79*	-.83*	.25	.04	-.15	.08	.10	68.66 (13.31)
2. Self-efficacy upper	77.97 (11.07)	.72**	–	-.38	.13	.24	.05	.17	.16	90.47 (5.37)
3. Self-efficacy range	33.41 (11.27)	-.59*	.03	–	-.20	.10	.28	.09	-.09	21.81 (10.43)
4. Familiarity	2.20 (.55)	.34	.40	-.19	–	-.00	.27	.33	.30	2.66 (.41)
5. Knowledge - quantity	1.61 (1.91)	-.13	-.18	-.07	.18	–	.83**	.32	.38	4.44 (2.81)
6. Knowledge - quality	–	.06	.09	-.04	.65**	.82**	–	.59*	.42	–
7. Application – quantity	3.69 (2.12)	.18	.09	-.31	.13	.39	.43	–	.61**	6.50 (2.45)
8. Application - quality	–	.14	.10	-.31	.50*	.54*	.66**	.60**	–	–

Note. Pretest data are in the lower triangle and posttest data are in the upper triangle. $M_1(SD_1)$ = Mean and standard deviation of each variable in the pretest; $M_2(SD_2)$ = Mean and standard deviation of each variable in the posttest. **$p < .01$. *$p < .05$.

Table 3
Perceptions, attitudes, and experiences in infusing SRL of emerging and advanced teachers.

Group similarities	Broad themes	Group differences
Both groups reported several barriers that inhibited their ability to embed SRL principles	The nature of challenges experienced during SRL implementation	The advanced group focused more on internal processes and the clarity of the SRL concept, whereas the emerging group devoted most attention to the role of external factors. The advanced group also expressed more optimism in overcoming the challenges
Both groups valued the importance of SRL-promoting practices, but both struggled to implement the practices at the level they desired	Readiness to implement SRL-promoting practices	The advanced group expressed greater enthusiasm about implementing SRL and expressed high level of independence in their attempts. The emerging group focused on needed additional external supports and guidance
Both groups stressed the value of promoting autonomy-supportive practices	Importance and nature of autonomy-supportive practices	The advanced group focused on the broad application of autonomy supports throughout the learning process whereas the emerging group focused more narrowly on student choice

after the PD, $t(15) = 3.96$, $p < .05$, $d = 0.99$. Thus, at posttest, the difference between teachers' perceived skill in working with students perceived as higher- and lower-achieving was substantially smaller.

Finally, the quantity and quality metrics for the SRL application measure showed large, statistically significant gains following the PD workshop. Thus, teachers conveyed a greater number of SRL strategies at posttest than pretest, $t(15) = 6.14$, $p < .05$, $d = 1.54$, when describing how to enhance student SRL functioning. The overall quality (i.e., breadth, strategy explanation, and action plan) of teachers' responses also showed statistically significant gains as reflected in the Wilcoxon Signed-Ranks test, $Z = 2.81$, $p < .05$, $r = .50$.

9.2. Teachers' perceptions, attitudes, and experiences about SRL implementation

An inductive, thematic analysis procedure was followed to identify major themes emerging from the interview data with advanced and emerging group teachers. The overarching objective was to compare and contrast the perceptions and attitudes of the extreme subgroups regarding SRL implementation practices (see Table 3 for a summary).

9.3. Perceived challenges and barriers

In terms of similarities, both groups expressed that implementing SRL practices in the classroom was difficult to do. One teacher from the advanced group noted, "So, I definitely [think] … SRL is the one that I struggled with the most with understanding how to infuse it, and seamlessly infuse it." Teachers from the emerging group agreed, with one of them underscoring:

> "I feel like I don't really know how to incorporate the students, their self-reflection, and their self-motivation in the process of doing lab activities or anything in science class. I [am] just not really sure how to do that."

However, the two groups were quite distinct in terms of the *types* of perceived challenges as well as their *reactions* to those challenges. In general, the advanced group focused more on their own understanding of SRL as the key challenge and conveyed positive perceptions regarding the potential for implementing SRL successfully. One teacher spoke about the ambiguous nature of SRL: "I think that when you are dealing with behavior and you're dealing with something like intrinsic motivation, it's just a murky area." Despite their perceptions of personal uncertainty with the construct, this group collectively exhibited a keen awareness as to why SRL may be a difficult concept to include in their instruction and expressed positivity about the implementation process. An advanced group teacher compared his experience with learning and infusing SRL with that of CT:

> "Computational thinking clicked easier for me seeing where it showed up [by seeing] more examples of lessons and how you could have some explicit pieces of that built-in. I will need some refresher, but I don't worry about it, I'll remember [SRL] once we start talking about it again."

The overall positivity and hopefulness of teachers' perceptions of overcoming SRL implementation challenges were expressed in several ways. One teacher noted that she was "not necessarily thinking about it in a negative way but thinking of it in any benefit for the future-type way." Along a similar line, a different advanced group teacher expressed:

> "I think as I feel more comfortable with the computational thinking part of it, then incorporating the SRL stuff will become easier because I'll already feel confident in understanding where the computational thinking is. And then [I'll feel comfortable with] being able to tie in SRL with it."

In short, when faced with challenges, the teachers in the advanced group appeared to look inward in terms of their own knowledge but exhibited a fairly positive attitude about moving forward with SRL implementation.

In contrast, teachers from the emerging group focused primarily on *external barriers* to which they had minimal control. One teacher focused on time constraints, stating, "We've got to get to the end. There's no time for any of this kind of fluff. And it's not really fluff. But it's - there's just no way to put [SRL] in right now." Some teachers in this group emphasized the challenges that students presented regarding SRL implementation. One teacher expressed:

> "But some of [the students] just are not interested in anything besides phones or video games. And then sometimes, even when I help them and I'll choose something that I think they would find interesting such as drug addiction, some of them still are not doing the work. Even in class, they are just sitting there and like staring off into the distance … they had time in class and they never asked for help."

This group of teachers also focused on parents serving as roadblocks and inhibitors to the regulatory process. One of the teachers expressed: "That's pretty hard to rework a kid's mind when even the parent is saying [SRL is] that's not the best way to learn." In short, unlike teachers in the advanced group, teachers in the emerging group displayed a more pessimistic attitude and often attributed their difficulties in implementation to factors that were beyond their control, such as parental influences, low student motivation, and lack of time.

9.4. Readiness to implement SRL practices

The second major theme pertained to teacher readiness to implement SRL practices. We defined readiness relative to the teachers' attitudes about SRL importance, their overall quality of affect about implementation, and their actual attempts to implement SRL processes. Both groups explicitly conveyed the importance of implementing SRL strategies into their instructional practices. An emerging group teacher noted:

> "My main takeaway [from the PD] is reminding me that we need to do more [SRL]. Because it's very easy to slide back into, as a teacher, maybe doing too much for the students and not getting them to self-regulate on their own enough."

Similarly, a teacher in the advanced group justified the importance of cultivating SRL skills in students, stating:

> "I think that there are, especially for teenagers, enormous amounts of benefits in helping them understand, helping them to externalize their expectations for themselves and then be forced to face that […] I think that that is a powerful moment for them to realize that they're accountable to themselves."

Despite this convergence across groups, the two groups diverged in terms of their *level of excitement* or enthusiasm for SRL implementation and the *level of independence* they were willing to take on to improve their implementation skills. Broadly speaking, the advanced group expressed excitement toward their plans to implement SRL principles and appeared to make concerted efforts to implement SRL in the best possible way. One of the advanced teachers implemented a goal setting structure in his lesson and underscored his enthusiasm for students' attempts to use goals within a lesson and for taking it seriously:

> "They're super honest about whether they think they met their goal or not, which is, I think, really interesting … they've been super hard themselves and we've had seven or eight units this year already, and so I was pretty proud of them."

The advanced group felt confident in their abilities to craft lesson plans infused with SRL and expressed excitement toward the plans and their ability to support students. Another teacher in the advanced group enthusiastically noted:

> "I love the idea of explicit goal setting and how that links to [a student's] ability to view themselves as successful. I like just that idea of creating intrinsic motivation by showing [success] being task-oriented, rather than talent-driven."

The teachers from the advanced group also spoke in detail about proactively developing ways to implement specific SRL practices, and, again, expressed their ideas with a positive and enthusiastic tone. One teacher expressed the following practice used in her class:

> "I would have them actually predict what they thought they were going to get on the exam based off of the preparation for it … I had them do it on a little index card. And then after I graded it, I put the grade that they earned on the index card, and I handed it back to them and I had given them a couple of prompting questions to think about. Did I perform as well as I thought I would? If I did, what worked for me so that I can remember to do it in the future? If they didn't perform as well as they thought they would, maybe what are some things that I should try to avoid in my studying or ways that I can change my studying to help me better understand the concepts? And I found that I actually got a lot of positive feedback from students when I was doing [the reflection on the card]. That it was helping them learn that not every study technique works for everybody."

On the other hand, the emerging group did not provide much detail about SRL practices they have attempted or implemented in their lesson plans. They also conveyed mixed feelings and doubts about the prospects for implementation as well as some ambiguity regarding their intentions for doing so. One of the teachers noted, "When I think about the self-monitoring throughout or self-control and those kinds of things, like their performances, I don't really even know where I would put [those SRL components] into their activity." Similarly, another teacher indicated:

> "I feel like … I don't really know how to incorporate the students' self-reflection and their self-motivation in the process of like doing lab activities or anything in science class. I am just not really sure how to do that."

The emerging group of teachers also seemed to doubt whether SRL implementation was even a possibility in their classroom. One teacher expressed positive thoughts about SRL in general but noted, "But right now, there's no way [to include SRL]. There's no way between now and like the first of May that I will be doing that."

In addition to consistent doubts about SRL implementation, teachers in the emerging group did not display the level of independence exhibited by the advanced group in terms of translating concepts from the PD to their lesson. As noted in the perceived challenge domain, the emerging group focused on their lack of experiences and/or need for additional supports and assistance. For example, one of the teachers stated, "I wanted to hear from [the instructor] I guess more realistic examples of how you as a teacher can get the kid to start being a self-regulated learner", while another one conveyed, "It was very interesting, but I thought the professional development that we had was much less explicit and clear."

These results reported in this section make sense in terms of how the two extreme subgroups were defined. The advanced group reflected teachers who exhibited strong SRL skills following the PD experience, and thus, were ready to begin the implementation process more readily than the emerging group.

9.5. Autonomy-supportive practices

Similar to the first two broad themes, there was convergence in teacher perspectives regarding the importance of cultivating student autonomy in the classroom. Teachers from both groups shared specific examples of what they have done with their students to promote autonomy-supportive practices (e.g., asking what students need/want, creating independent work time, encouraging student voice; Reeve et al., 2008). For example, one teacher in the emerging group created independent work time for students to read through informational feedback that students would have otherwise likely ignored: "I actually make them in class spend time where they're looking at [teacher] comments. They have to hit resolve [on Google Sheets] after they've read them." A teacher in the advanced group explained how SRL could be used to offer encouragement to students and help them build self-confidence in their understanding, "There's a way [students] can monitor [their] own learning and that [students] can build some confidence in [their] understanding of this or that."

While both groups acknowledged the importance of using autonomy-supportive instructional practices, their approaches to promoting student autonomy were quite distinct. Teachers from the advanced group discussed autonomy support in a more holistic and comprehensive way, whereas the emerging group focused more narrowly and simply on providing student choice. The underlying goal of the teachers in the advanced group was to cultivate a safe and trusting learning environment for students to be confident, independent thinkers and learners. For example, one teacher shared:

> "Being able to have them engage in the process actually helps them understand their learning process and that everyone's learning process might be a little different. I think that that is probably what stood out the most and how making this an intentional practice within your classroom helps the kids understand maybe why they're performing better on some assessments, but not others based off of the way they're preparing for it."

Another advanced group teacher noted, "I think that there are, especially for teenagers, you know, enormous amounts of benefits to helping them understand, helping them to externalize their expectations for themselves and then be forced to sort of face [the outcome]." He later added, "But also taking the time to explain [the outcome] and talk with [students] about that, and just how much that does for a kid to motivate them and let them know that you believe in them." The third teacher in the advanced group noted, "I feel like some of this type of stuff [SRL] that can help with that. It's skill-related; there's a way you can monitor your own learning and that you can build some confidence in your understanding of this or that."

In contrast, the emerging group offered a narrower perspective on autonomy support. They focused on creating opportunities for students to choose and make decisions, whether deciding on a process for a task or choosing a topic of interest. One teacher shared an opportunity she created for her students to make choices for an enzyme investigation:

> "As an example [of task analysis] would be when students had to come up with what they were going to use as their independent variable is the enzyme activity. And [they had to explain] why they were going to do it. And how much they were going to do it. And how they were going to set up the lab and what they were going to use to collect their data. And so, I made them [answer those questions] as a pre-lab activity."

Another teacher's comment reflected this narrow perspective:

"Many times, we are told that we need to do stuff that is more engaging … the best thing I can do when it comes to engaging them in research papers and data analysis is letting them choose stuff that they're interested in."

10. Discussion

The current study examined the growth of teacher SRL knowledge and application skills following a PD program, and explored their perceptions, attitudes, and experiences when attempting to infuse SRL processes into their lessons. Broadly speaking, we found that although the teachers, on average, exhibited large gain scores across all quantitative measures, there were differences in the patterns of growth. This differential pattern among teachers (i.e., advanced and emerging subgroups) appeared to relate to differences in their perceptions and attitudes when implementing SRL practices.

11. Changes in teacher knowledge, beliefs, and conceptualization skills

The PD workshop provided in this study entailed a structured, 32-h experience involving didactics, small group reflection activities, guided practice, and independent opportunities for linking SRL principles to science lesson plans. Consistent with the emerging literature regarding the effectiveness of teacher-focused SRL PD training (Kramarski & Michalsky, 2015; Perels et al., 2009; Perry et al., 2007), we found that the teachers displayed large increases across all outcomes: SRL knowledge and familiarity, self-efficacy, and application or case conceptualization skills.

In addition to these large effect sizes and the convergence of our results with the SRL PD literature, this study adds to the literature in a couple of important ways. First, the multi-method approach used to assess teacher outcomes enabled us to draw more credible and substantiated conclusions regarding shifts in these outcomes. For example, we included a free-response measure and a self-report measure targeting SRL knowledge (i.e., familiarity) as well as a free-response measure addressing the application of their SRL knowledge to a hypothetical case. For both free-response questions, we also included two general metrics: quantity (i.e., number of SRL processes reported) and quality (i.e., breadth and depth of coverage of the construct). Collectively, this multi-method approach, which parallels recent trends and recommendations by SRL scholars (Callan & Cleary, 2018), enabled us to provide more compelling and clear evidence regarding shifts in teachers' overall understanding of SRL.

Second, our unique approach to measuring teacher self-efficacy enabled us to gather more nuanced information regarding variations in their efficacy to work with two distinct groups of students; that is, students whom teachers *perceived* as struggling or not performing at an adequate level (i.e., academically at-risk) and those *perceived* as higher achieving. Teachers were substantially more confident in their ability to apply SRL principles with higher-achieving than struggling students. Further, although we found large pretest-posttest changes in teacher efficacy regarding the type of students, the level of growth in efficacy for working with youth perceived as struggling in school was descriptively larger. While empowering and enabling teachers and other school personnel to work effectively with all students is important, it is particularly essential for them to interact effectively with students whom they perceive as struggling. Prior research shows that efficacious teachers tend to put more effort into teaching, show persistence in helping struggling students, and are generally more receptive to new instructional practices than teachers with lower self-efficacy (Guskey, 1988; Kitsantas, 2012). Further, the literature conveys that many teachers and other school personnel believe that they are ineffective when working with students exhibiting motivational or regulatory weaknesses, and need additional support to do so (Cleary, 2009; Coalition for Psychology in Schools and Education, 2006; Spruce & Bol, 2015).

12. Thematic analysis of teacher perceptions and experiences

Another key aspect of this study was its focus on examining teacher perceptions, attitudes, and reactions to SRL implementation. To our knowledge, very few studies have attempted to identify groups of teachers showing differential responsiveness to an SRL PD experience and to explore whether these groups varied in their

perceptions and attitudes about SRL implementation. Our basic premise in creating the two extreme groups was that while statistically and clinically significant group changes often occur following PD training experiences, one cannot assume that all of the teachers will show this level of improvement or growth (Winne, 2017).

The two extreme groups identified in our study reflected those who showed either very high levels (i.e., advanced) or low levels (i.e., emerging) of SRL knowledge and skills at posttest. Broadly speaking, the advanced group was flexible, self-directed, and highly positive and hopeful about SRL implementation, whereas the emerging group seemed to focus more on external or uncontrollable factors and expressed more doubts about their prospects for implementing SRL principles. These groups also differed in terms of the content of their primary concerns or challenges as well as their overall approach to SRL implementation. For example, while the advanced group focused more on internal challenges and barriers (e.g., their own understanding of SRL and how to improve it), the emerging group emphasized several external constraints, such as limited time, student disengagement, and parental influences. Further, the advanced group expressed a more positive perspective about their ability to control and direct how to implement SRL practices, whereas the emerging group frequently and clearly expressed their desire for more explicit examples and additional training or teaching support. Finally, the advanced group exhibited a more expansive view of autonomy-supportive practices than the emerging group. Reeve et al. (2008) identified several empirically based, autonomy-supportive instructional practices, such as listening, asking what students want, offering hints and encouragement, being responsive, and encouraging student voice. In our study, the advanced group of teachers emphasized a broader range of these practices than the emerging group.

Our findings dovetail existing PD and SRL theory and research in important ways. First, the two extreme groups (i.e., advanced and emerging) closely parallel Zimmerman (2008) depiction of *naïve* and *skillful* self-regulated learners. Much like the advanced group, skillful self-regulated learners are more positive and intrinsically invested and often are more adaptive and strategic in their learning. Conversely, the emerging group showed several similarities with naïve learners, such as low perceptions of control, greater levels of reactivity and negative affect, and a fairly simplistic approach to SRL application. Our results also parallel SRL PD research showing that teachers who exhibit increased levels and more positive perceptions of SRL knowledge and skills following PD experiences are more likely to implement these processes in the classroom (Dignath-van Ewijik & van der Werf, 2012; Peeters et al., 2014). That is, the advanced group, who displayed greater knowledge and more positive affect and beliefs about SRL than the emergent group, appeared to implement SRL more effectively in the classroom.

Clarke and Hollingsworth's (2002) Interconnected Model of Professional Growth offers another interesting perspective for understanding the distinctions between the two groups. From this perspective, teacher change can occur in four domains (i.e., practice, personal, consequences, and external) through the process of reflection and enaction. Although the advanced and emerging groups were both exposed to the SRL PD (external domain), the differences in their level of knowledge and quality of beliefs and affect (personal domain) appear to relate to the observed differences in their attempts to implement or enact SRL practices in their classroom (practice domain).

13. Implications

Our results have important implications for teacher education and PD activities implemented in school contexts. Of greatest importance is that although teachers will, on average, benefit from SRL PD activities, one cannot assume that all teachers will show positive changes. When teachers display differential outcomes following PD, it suggests that certain teachers will need additional or more expansive support to help them integrate and embed SRL principles in the classroom. In our study, those who did not show adequate growth in SRL knowledge and skills appeared to struggle at implementing SRL practices in an effective way.

Peters-Burton et al. (2020) developed an innovative approach for supporting the development of SRL skills in teachers whose regulatory skills are not well developed. In the study, the authors portioned the PD experience into three parts: (a) an intensive week focusing teachers on their own SRL, (b) an intensive week focusing on building SRL into existing lesson plans, and (c) follow-up meetings after teachers implemented the SRL-infused lessons, helping them to reflect and inform their instruction. During each cycle, teachers responded to an SRL microanalysis protocol (Cleary, 2011), which involved a series of contextualized questions about their regulation as they worked on lesson plans. Based on the microanalytic information, the teachers and providers of the PD were able to gain greater self-awareness about the quality of teacher goals and approaches to lesson plan development. This enhanced awareness served as the basis for instructor modifications to the PD experience, and the types of goals teachers wanted to focus on regarding the SRL implementation process. Thus, teachers who fail to demonstrate growth in SRL skills during an initial PD experience may benefit from approaches that emphasize gathering and using formative data about their SRL skills to inform the nature of the PD activities (Peters-Burton et al., online first).

Another important implication of our study pertains to the recognition that implementation of SRL practices may vary based on teacher perceptions of student characteristics. In our study, teachers exhibited fairly low self-efficacy for working with students they perceived as academically at-risk, but much higher efficacy for working with higher achieving students. When individuals possess poor self-efficacy, they will often avoid or not engage in such activities (Zee & Koomen, 2016). Thus, it is important to consider teacher self-efficacy and other types of perceptions affecting their implementation of SRL with regard to the range of students with whom they routinely work.

14. Limitations

There were several limitations of this study. First, although we intentionally focused on a fairly narrow and small number of high school science teachers from the same school district, the generalizability of our findings is limited. Future research needs to include larger and more diverse samples across academic content areas in order to evaluate the generalizability of the current results (Yin, 2003). Second, because we did not include a comparison or control group, we cannot draw causal inferences regarding the effects of the SRL PD workshop. Similarly, one cannot make definitive statements regarding the relationship between teacher posttest SRL scores (i.e., how the two subgroups were formed) and their perceptions and reactions to implementing SRL practices in the classroom. Finally, although we utilized a multi-method approach to evaluate the quantitative research questions, we only used a single method and source of data (i.e., interviews) to evaluate qualitative differences among teachers. Future studies employing case study analyses should utilize multidimensional assessment approaches that enable the triangulation of such data. Despite these limitations, our findings support the idea that further and more widespread SRL PD opportunities for teachers have the potential to benefit students, particularly students identified as academically at-risk.

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