Sustainable school improvement: Enhancing school middle-leaders' epistemic cognition for teaching about self-regulated learning

By

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Contents

Abstract

Background:

Schools are complex adaptive systems engaged in a dynamic process of continuous improvement. School-improvement initiatives require a substantial investment (e.g., financial, human); yet, many fail to sustain beyond the initial implementation phase, raising concerns about knowledge translation from research laboratory to authentic classrooms. The present study investigated sustainability of school-improvement initiatives from three perspectives: (1) School middle-leaders (defined as fulfilling a dual role – leading and teaching) are uniquely positioned to support the sustainability of school improvement initiatives, (2) Epistemic cognition for teaching, and its sub-process epistemic reflexivity, have surfaced as complex processes underpinning teaching behaviours, namely, the uptake of school improvement initiatives, and (3) Self-regulated learning (SRL) is an essential life skill that can't be left to chance – SRL needs explicit instruction.

Very little research has been uncovered that explicitly considers middle-leaders' epistemic cognition for teaching about SRL, nor how to promote high-quality epistemic cognition for teaching to support sustainability of school improvement initiatives about SRL.

Aims:

The aims of this thesis are to:

- Advance thinking about epistemic cognition for teaching, with a focus on the sub-process of epistemic reflexivity for teaching.
- Develop existing Professional Learning Community models of professional education to include explicit prompts for engagement in epistemic reflexivity (PLC-ER).
- Ascertain if and how a PLC-ER changes middle-leaders' epistemic cognition and teaching practice about SRL over time.
- Determine whether changes in middle-leaders' epistemic cognition for teaching about SRL and teaching practice about SRL have flow-on effects for regular classroom teachers' beliefs about SRL, and for students' SRL behaviours.

Design:

A microgenetic investigation.

Participants and Setting:

Sixteen school middle-leaders, 22 regular classroom teachers and 305 students at an Independent K-12 School in Melbourne, Australia.

Methods:

Middle-leaders participated in a 12-week PLC-ER about SRL (Weeks 1-12). Data were collected at 7 time points, namely, before (Week 0), during (Weeks 2, 4, 6, 8) and after (Weeks 12 and 52) the PLC-ER via questionnaires, think-alouds, lesson plans, classroom observations, learning protocols and researcher notes. Data were analysed using deductive and inductive coding approaches, and statistical procedures.

Results:

Data analyses showed that prior to the PLC-ER about SRL, middle-leaders' epistemic cognition, as measured via the quality of their knowledge and beliefs about SRL, and their epistemic reflexivity about SRL, was impoverished. In addition, coding of middle-leaders' lesson observations indicated that they spent small amounts of time explicitly teaching SRL strategies. Statistically significant improvements were recorded immediately after the PLC-ER about SRL in middle-leaders' epistemic cognition for teaching and their teaching practice about SRL. Flow-on effects included variable changes in regular classroom teachers' beliefs about SRL and substantial enhancement of students' SRL behaviours over time.

Conclusions:

The state of middle-leaders' epistemic cognition and teaching practice about SRL, observed prior to the PLC-ER about SRL, may explain the lack of explicit teaching of SRL strategies commonly reported in classroom observation studies. Results suggest that a PLC-ER about SRL offers an avenue to support the sustainability of school improvement initiatives about SRL. Future research and educational implications are discussed.

Keywords:

Complex Adaptive Systems, Sustainability, School middle-leaders, Epistemic Cognition for teaching, Self-Regulated Learning

Declaration

I certify that this thesis does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any university; and that to the best of my knowledge and belief it does not contain any material previously published or written by another person except where due reference is made in the text.

Signed: Shyam Barr

Date: 06/12/2020

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Thesis-Related Publications and Presentations

Barr, S., & Askell-Williams, H. (2020). Changes in teachers' epistemic cognition about self-regulated learning as they engaged in a researcher-facilitated professional learning community. *Asia Pacific Journal of Teacher Education*, *48*(2), 187-212. https://doi.org/10.1080/1359866X.2019.1599098

Barr, S., & Askell-Williams, H. (2020). Upgrading professional learning communities to enhance teachers' epistemic reflexivity about self-regulated learning. In J. Fox, C. Alexander, & T. Aspland (Eds.), *Teacher education in globalised times* (pp. 349-366). Springer. https://doi.org/10.1007/978-981-15-4124-7_19

Askell-Williams, H., Barr, S. & Ngendahayo, E. (2019). The quality of knowledge and beliefs that teachers use when solving teaching and learning problems. In H. Askell-Williams, and J. Orrell (Eds.), *Problem solving for teaching and learning* (pp. 112-124). Routledge. https://doi.org/10.4324/9780429400902-9

Barr, S. & Askell-Williams, H. (2018). *Changes in teachers' knowledge and beliefs about self-regulated learning during their engagement with a guided professional learning community: A case study*. Paper presented at the 2018 ATEA and TEFANZ Conference on Teacher Education In and For Uncertain Times, Melbourne, Australia. Abstract retrieved from https://atea.edu.au/wp-content/uploads/atea-tefanz-2018-conference-handbook-final-jun25.pdf

Barr, S. (2017). *A review of research on teachers' beliefs about self-regulated learning.* Paper presented at the 2017 Flinders University Post Graduate Scholars Conference on Knowledge and Education: Diversity and Difference, Adelaide, Australia. Abstract retrieved from https://flo.flinders.edu.au/pluginfile.php/2496793/mod_resource/content/0/PostGraduate%20Conference%202017-ABSTRACTS.pdf

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Glossary

The following list contains essential terminology from a range of relevant fields.

Complex adaptive system	Open system consisting of multiple, different and interdependent systems, engaged in a process of sustainability. Note: Changes that occur in a complex adaptive system are considered to be emergent, unpredictable and potentially impermanent.
Epistemic cognition for teaching	Thinking about knowledge and knowing about teaching (i.e., an educator's process of constructing their own knowledge and supporting students' knowledge construction)
Professional learning community for epistemic reflexivity (PLC-ER)	A professional learning community that incorporates educative tools for epistemic reflexivity for teaching.
School middle-leader	Category of school-leadership that involve both leading and teaching. Includes Year level coordinators (e.g., Year 7 Coordinator) and Heads of Departments or Faculty leaders (e.g., Head of Science, English Coordinator).
Self-regulated learning (SRL)	Complex process (Klug, Ogrin, Keller, Ihringer, & Schmitz, 2011) of planning, monitoring and evaluating learning influenced by a range of variables (e.g., cognition, self-efficacy), particularly that of metacognition (Hadwin, Davis, Bakhtiar, & Winne, 2019; Winne & Hadwin, 1998)
Sustainability	System's continuous, dynamic and non-linear process of improvement (in response to its goals/needs)

1. INTRODUCTION

The focus of this thesis is to report a microgenetic investigation of the emergent changes within a school as school middle-leaders participated in an improvement initiative, namely a Professional Learning Community for Epistemic Reflexivity (PLC-ER) about self-regulated learning (SRL). In this introductory chapter, I position schools as Complex Adaptive Systems, engaged in an ongoing and dynamic process of improvement. In conjunction with the investigation of the emergent changes, I will also consider and provide an overview of sustainability in relation to school improvement initiatives, in response to a reported claim that school improvement initiatives rarely sustain beyond initial funding and implementation and that there is disparity in the way sustainability is conceived by researchers (Koh & Askell-Williams, 2020). I will also discuss the role of leaders in fostering the conditions for sustainability and highlight school middle-leaders as an understudied group. Furthermore, I will emphasise epistemic cognition for teaching as an emerging area of research that plays a moderating role in the adoption and continuous adaptations of school improvement initiatives. The chapter will outline the research rationale, aims, questions and hypotheses.

1.1. Schools are Complex Adaptive Systems

Researchers have documented that systems qualify as complex adaptive systems if:

- They are open systems consisting of multiple, different and interdependent sub-systems (Rickles, Hawe, & Shiell, 2007; Rosas, 2017; Shiell, Hawe, & Gold, 2008).
- They are engaged in a continuous, dynamic and non-linear process of improvement (Rickles et al., 2007; Shiell et al., 2008).
- Changes that occur in the system are emergent and therefore, unpredictable and often impermanent (Rosas, 2017; Schneider & Somers, 2006).

Each of these characteristics is outlined in the following paragraphs in order to establish that schools are complex adaptive systems.

Schools are *open systems* as they occur in real-world settings and are exposed to numerous external influences. For example, schools are subject to government policy, are influenced by parent communities and are impacted by global demand. In addition, schools themselves consist of *various, interacting systems*. For example, schools consist of different groups of students, parents, teachers and school leaders, with groups interacting with each other and with school systems such as curriculum, policies, procedures and vision. Furthermore, a school exists within a

larger complex adaptive system of local or national governing bodies. For example, Australian schools must follow Australian Government policies.

Additionally, schools are committed to a cycle of *continuous improvement* with an intention to best equip students for the future. Rickles et al. (2007) referred to *continuous improvement* as when a "system never settles into a steady state of behaviour" (p. 935). A continuous improvement process is *dynamic* because it is based on different positive and negative feedback loops (Koh & Askell-Williams, 2020). Furthermore, continuous improvement is *non-linear* (Shiell et al., 2008) and that inputs in non-linear systems are *not* proportionate to their outputs. For example, a large school intervention (such as, a professional education program for all staff) may result in small change in teaching practice and subsequent student achievement. Similarly, a small school intervention (say, a professional education program with school-leaders) may result in large change in teaching practice and subsequent student achievement. This inconsistency between input and output is commonly known as the "butterfly effect" (Cziko, 1989; Kauffman, 1993; Schneider & Somers, 2006) and was originally coined in the context of chaotic equations used to predict weather by MIT meteorologist Edward Lorenz (1963, 1979).

Due to the continuous, dynamic and non-linear process, changes that occur in schools are emergent and therefore, unpredictable and often impermanent. Emergent changes result from reciprocal interactions between parts of a school system (such as, teaching staff, internal policy), and with the wider educational environment (Koh & Askell-Williams, 2020; Schneider & Somers, 2006). This view shares similarities with Bandura's model of reciprocal determinism (1978, 2001) whereby a person's behaviour is reciprocally influenced by their own personal factors and the environment. Rickles et al. (2007) argued that from these interactions, changes emerge in a complex adaptive system "that cannot be reduced to the subunits (and that cannot be readily deduced from the subunits and their interactions)" (p. 934). There are many paths to generate emergent changes (Rickles et al., 2007), so understanding the conditions in which emergent changes occur, rather than identifying sources of change, is arguably more fruitful. Emergent changes are more than just outputs, they also act as inputs in a complex adaptive system (Rickles et al., 2007). When acting as inputs, emergent changes are essentially feedback in a complex adaptive system and occur at both macro and micro levels. This feedback, whether positive or negative, forms part of the interactions occurring between units, thus emphasising the non-linear nature of the system. It is through this cycle of feedback and interactions that a complex adaptive system achieves a new normal (Schneider & Somers, 2006).

1.2. Sustainability of School Improvement Initiatives

School improvement initiatives commonly occur in schools (complex adaptive systems) with the intention of achieving changes in school, teacher and student level outcomes (for example, Gaikhorst, Beishuizen, Zijlstra, & Volman, 2017; Kramarski & Kohen, 2017). School-improvement initiatives require a substantial school investment (for example, financial, human, time), yet few are *sustained* beyond an initial implementation phase (Hargreaves & Goodson, 2006; Heirweg, De Smul, Merchie, Devos, & Van Keer, 2020), raising concerns about knowledge translation from research laboratory to authentic, everyday classroom experiences.

The verb *to sustain* has a Latin origin (sustineo) which means "to keep up". The term *sustainability* is most often used in relation to the "keeping up", or survival, of the natural environment, be it planet, species or natural resources. In many educational contexts, sustainability holds this meaning. For example, OECD (2018) stated that "children entering school in 2018 will need to abandon the notion that [physical] resources are limitless…and will need to value…sustainability" (p. 3). However, sustainability in the context of *school improvement initiatives* refers to the longevity of an improvement initiative within a school. While sustainability in the context of school improvement has been discussed in educational contexts for over a decade (for example, Fullan, 2005; Hargreaves & Fink, 2005; McIntosh, Horner, & Sugai, 2009), two potentially conflicting views of sustainability have permeated the fields of Education and Health.

Some researchers have conceptualised sustainability of improvement initiatives as *conditions for* (Chambers, Glasgow, & Stange, 2013; McIntosh et al., 2009) and *high-fidelity implementation of* an initiative beyond its formal implementation period (for example, Han & Weiss, 2005; Shelton, Cooper, & Stirman, 2018). This view is commonly understood as focusing on *outcome* (for example, Koh & Askell-Williams, 2020) given its focus on maintaining a "high-fidelity" implementation of the innovation. The aim of achieving a high-fidelity outcome suggests a "linear system" (Rickles et al., 2007), a top-down process of implementation, in which teachers are mere receivers and reproducers of information, changes are predictable and if changes do not occur, the initiative has not been sustained. In this deterministic type of view an innovation is replicated in a school system until the innovation becomes the new normal. In other words, the view is that sustainability is a technical problem that can be easily solved through expertise (Heifetz, 2009).

The aim of high fidelity implementation ignores the changing nature of schools (Johnson, Hays, Center, & Daley, 2004). Sustainability is therefore an *adaptive* challenge (Fullan, 2005, p. 14), a challenge that has unclear problems and solutions (Heifetz, 2009). When schools are conceived of as complex adaptive systems, sustainability of a school improvement initiative is an emergent, unpredictable and potentially impermanent product of the system's continuous, dynamic and

non-linear process of improvement. It encompasses any direct or flow-on effect that reasonably relates to the original intentions of the initiative, where “reasonable” means that spontaneous effects may not relate to the intentions of the initiative and do not indicate sustainability. No matter the proximity to high-fidelity implementation, when a change in a system resembles the original intentions of the initiative, a level of sustainability has been achieved in that moment. Note that the term “moment” is used to recognise that schools are engaged in continuous cycles of improvement and the sustainability of one initiative may well be replaced by another initiative depending on the needs of the system at any point in time.

Few studies have conceived of sustainability and school improvement as part of a complex adaptive system and very few have conducted research of this nature in real-world settings. For example, Koh and Askell-Williams (2020) conducted a scoping review of 1111 peer-reviewed journals and reported that only fifteen articles conceived of schools as complex adaptive systems (using the criteria of dynamic, contextual, inter-dependent, agents, networks and emergence). None of the articles reviewed presented a substantive understanding of sustainability as a process of continuous improvement within a school. Most of the articles found were in the field of health and wellbeing, suggesting an opportunity in the field of self-regulated learning. Koh and Askell-Williams argued that “initiatives that conceptualize schools as [complex adaptive systems] for implementation, but fail to recognize sustainability as an emergent product of [complex adaptive systems], have only partially conceptualized schools as [complex adaptive systems], because they have not fully considered the complexity, unpredictability and non-linearity of school systems” (p. 19). In their conclusion, they argued that the articles reviewed were limited in their conceptualisations of schools and sustainability, as well as “their reliance on snapshot data” (p. 27). Indeed, Koh and Askell-Williams suggested a need for studies to move beyond extensive descriptions of innovations to cover schools as complex adaptive systems (for example, “stakeholders’ dispositions, actions and interactions”, p. 27). They concluded that “future studies should focus on further identifying the synergies between schools as CAS [complex adaptive systems] and school improvements [school improvement initiatives], and to collect longitudinal, practice-based evidence from real world school settings so that change and points of emergence can be monitored and modelled positively” (p. 28). The present study is an initial response to this call to action.

1.3. Middle-Leadership and Sustainability of Improvement Initiatives

There is consensus that leaders, as agents within a complex adaptive system, can foster the conditions for the sustainability of school improvement initiatives (for example, Hargreaves & Fink, 2005; Schneider & Somers, 2006). For example, Fullan (2006), a prominent author in the field of

sustainable school improvement, advocated for eight elements of sustainability in schools (refer Table 1.1.).

Table 1.1. Elements of sustainability in schools (Fullan, 2006)

Element	Brief description
Public service with moral purpose	Fullan defined moral purpose in the context of schools as "(i) commitment to raising the bar and closing the gap of student achievement; (ii) treating people with respect, which is not to say low expectations; and (iii) orientation to improving the environment including other schools in the district" (Fullan, 2006, p. 115). Fullan argued that school activities should be driven by this moral purpose.
Commitment to changing context at all levels	"Contexts are the structures and cultures within which one works… [e.g.,] school/community, district, and system" (Fullan, 2006, p. 116). Implementation scientists often explain away emergent changes to context, but Fullan argued that context should be the focus of the change.
Lateral capacity-building through networks	Simply, this is peer-learning that occurs internal to an organisation or more broadly through professional networks.
New vertical relationships co-dependent and encompassing both capacity-building and accountability	Strengthening relationships between school, local government and national education system that balances direction and autonomy for educators.
Deep learning	Commitment to ongoing problem solving and improvement.
Dual commitment to short-term and long-term results	Fullan defined this element as follows: "organisations set targets and take action to obtain early results, intervene in situations of terrible performance, all the while investing in the [other] sustainability capacity-building elements" (Fullan, 2006, p. 120)
Cyclical energising	Sustainability dependent on an organisation's ability to engage in activities that refuel itself for another cycle of improvement.
Long lever of leadership	Leadership across the school need to act as system thinkers

According to Fullan (2006), all eight elements are needed for sustainability and that leaders play a prominent role in the realisation of these elements. Stoll and Kools (2017) support the importance of leadership reporting "modelling and growing learning leadership" as one of seven action-oriented dimensions of a sustainable school learning organisation in a review of articles about sustainable school improvement. Stoll and Kools argued that "leadership brings the separate parts of the [learning organisation] together to ensure that the whole adds up coherently and is sustainable" (p. 11). Furthermore, Gaikhorst et al. (2017), in a study of the long-term effects of a professional development intervention in schools, discussed the importance of good leadership, in which teacher professional competence was recognised by school leaders.

Several reviews about the role of school middle-leaders (for example, heads of department/faculty, subject-co-ordinators, pastoral care leaders) have emerged in the past 12

years (for example, Bennett, Woods, Wise, & Newton, 2007; Harris, Jones, Ismail, & Nguyen, 2019), highlighting that middle-leaders play a particularly important role in sustainable school improvement. Drawing on a definition from Grootenboer, Edwards-Groves, and Rönnerman (2015), Gurr (2019) defined *middle-leaders* as those individuals who fulfil dual roles in schools – leading and teaching – excluding those in senior leadership roles (for example, principal and deputy principal, head of school, head of campus). Gurr acknowledged an inherent complexity with the term *middle-leader* due to differing parameters of a middle-leader across educational institutions. According to De Nobile (2018b), the term *middle-leaders* symbolises a conceptual shift away from middle managers – an evolution of management style and administrative tasks toward strategic activities that have a greater focus on staff professional development (Bennett et al., 2007). Appropriately, the term "middle" is used for this group of leaders due to the tension they experience between expectations from senior managers and expectations from their teams of teachers (Bennett et al., 2007). Grootenboer, Edwards-Groves, and Rönnerman (2019) stated that middle leaders were uniquely positioned "as a 'bridge and broker' between senior management and the teaching staff" (p. 253).

As a "powerful filter", middle-leaders are considered "key school-based leaders [who] drive educational change" (Grootenboer et al., 2019, p. 253) and play a crucial role in the school-wide implementation of high quality teaching and learning experiences (Bennett et al., 2007; Harris et al., 2019). Due to their dual roles, middle-leaders are particularly well-positioned to influence sustainability of school improvement initiatives. Indeed, middle-leaders form part of the *environment* influencing *personal* and *behavioural* factors of regular classroom teachers. For example, middle-leaders can model teaching practice for regular classroom teachers and support regular classroom teachers to learn in a *zone of proximal development,* whereby optimum learning occurs due to social interaction between teacher and student (Vygotsky, 1987). In many ways, middle-leaders might act as a 'more-knowledgeable other' (particularly in the context of knowing the school direction)(Vygotsky, 1987), due to their exposure to conversations at a leadership level. However, their ability to create conditions for sustainability of school improvement initiatives is likely influenced by various factors. One of these factors is of interest to the present study: epistemic cognition for teaching (discussed later in this chapter).

Researchers in the field of educational leadership have typically focussed on the role of senior leaders (for example, Principals; Grootenboer et al., 2019; Gurr, 2019; Harris et al., 2019) or dedicated their attention to different models of leadership (for example, distributed leadership, instructional leadership)(Gumus, Bellibas, Esen, & Gumus, 2018; Harris et al., 2019). In doing so they appear not to have considered the role of middle leaders in educational change. Indeed, recent review studies have reported only small increases in the number of empirical studies on

middle leadership in schools (De Nobile, 2018a; Harris et al., 2019) and numbers substantially less than the growing number of research studies available for senior leaders. Despite this imbalance, there is growing interest in the field of middle-leaders in schools, as was evident in a 2019 special issue in *School Leadership and Management* titled “Understanding Middle Leadership: Practices and Policies”. However, the body of available research is still very limited. Researchers have argued for more research in the field of *middle-leadership* (Harris et al., 2019). Grootenboer et al. (2019) commented that “articles [within the special issue] mark out middle leadership as an important educational phenomenon worthy of significant future investment for accomplishing site based [sic] education development” (p. 254). The importance of school middle-leadership and its role in fostering conditions for sustainability is acknowledged within the present study.

1.4. Epistemic Cognition for Teaching: An Overview

The term *epistemic* originates from the Greek word epistēmē (knowledge), while the term *cognition* relates to information processing or thinking. Therefore, *epistemic cognition* can be understood as how one thinks about knowledge and knowing (Buehl & Fives, 2016; Hofer & Bendixen, 2012). Epistemic terms have proliferated in the field of epistemic cognition (e.g., epistemology, epistemic beliefs, epistemic climate, epistemic orientations). While clarity of terms is certainly required, this discussion is not the focus of this thesis. Thus, consistent with Chinn, Buckland, and Samarapungavan (2011), epistemic cognition is viewed in this thesis as “an umbrella term”, its scope encompassing a broad set of thinking about all matters related to knowledge (p. 141). Under this umbrella, researchers studying in the field of epistemic cognition have focused on diverse array of topics, including epistemic beliefs, justification of knowledge and how beliefs about knowledge and knowing change over time (Muis & Singh, 2018).

Epistemic cognition has a well-established history in the context of learning. Since Perry’s stage model of knowledge acquisition (1970), the field of epistemic cognition has witnessed numerous developments. These developments include Kitchener’s three-level model of cognitive processing (with epistemic cognition the third level) (1983), Schommer’s multi-dimensional model of epistemological beliefs (1990), Hofer and Pintrich’s construct of epistemological theories (1997) that was later built on by D. Kuhn and Weinstock (2002) and Chinn, Buckland and Samarapungavan’s *Aims, Ideals and Reliable processes* (AIR) framework (2011).

Epistemic cognition for teaching has been argued as more complicated than models explaining epistemic cognition for learning (Fives, Barnes, Buehl, Mascadri, & Ziegler, 2017), and is still in its early stages of development. For example, Clark and Peterson’s seminal review on teacher thinking (1986) made no mention of epistemic cognition for teaching. It was only in the 1990s that Calderhead (1991, 1996) began to explore beliefs of teachers about different domains of

knowledge. In the past decade, interest in epistemic cognition for teaching has grown. Researchers have documented a relationship between epistemic cognition for teaching and how one engages in teaching (for example, Buehl & Fives, 2009; Greene, Sandoval, & Bråten, 2016), including the role of school middle-leadership. This body of research about epistemic cognition and teaching practice has offered new models of epistemic cognition for teaching (for example, Fives et al., 2017) and proposed new methods for achieving change in epistemic cognition for teaching (for example, Lunn Brownlee, Ferguson, & Ryan, 2017). However, it is worth noting that some of these researchers have positioned teachers as learners and have contributed to teachers' epistemic cognition for learning, rather than for learning *and* teaching (Barzilai & Chinn, 2018; Feucht, Lunn Brownlee, & Schraw, 2017). This has been acknowledged in recent papers (for example, Barnes, Fives, Mabrouk-Hattab, & SaizdeLaMora, 2020) that advocated for a greater focus on epistemic cognition for *teaching*. Additionally, models of epistemic cognition proposed in different domains have typically been theoretical (for example, Fives et al., 2017; Lunn Brownlee et al., 2017) and have not been applied in real-world settings. Moreover, researchers have advocated for the development of professional education initiatives that stimulate conceptual change in teachers' knowledge and beliefs (Vosniadou et al., 2020). Therefore, there is substantial opportunity to progress available models of epistemic cognition for teaching, both theoretically and practically.

When considering epistemic cognition for teaching, for learning, or for teaching and learning, there is consensus that epistemic cognition is domain specific and that it needs to be examined in specific contexts (Buehl & Fives, 2009; Hofer, 2000, 2018; Lunn Brownlee et al., 2017; Lunn Brownlee et al., 2019; Maggioni & Parkinson, 2008). Weinstock, Kienhues, Feucht, and Ryan (2017), in a paper comparing four different knowledge domains (Science, History, Critical thinking and Writing), provided a convincing argument to support the view that engagement in epistemic cognition is context specific, as it is "informed by knowledge domain characteristics, and with more knowledge and experience in a domain the type of reflexive practice will be intentionally targeted toward that domain" (p. 284). This is further evidenced by studies that have investigated epistemic cognition in specific domains: maths (for example, Depaepe, Verschaffel, & Kelchtermans, 2013), science (for example, Stathopoulou & Vosniadou, 2007; Vosniadou & Skopeliti, 2014), reading comprehension (for example, Strømsø & Kammerer, 2016) and epistemic cognition for teaching in the context of assessment (for example, Fives et al., 2017).

In the surge of research in the field of epistemic cognition over the past two decades, no study was found that explicitly considered school middle-leaders' epistemic cognition for teaching about self-regulated learning. For this reason, this foundational study focusses on the middle-leaders' role as a teacher first – that is, their own epistemic cognition for teaching.

1.5. Self-Regulated Learning

Self-regulating learning (SRL) is an umbrella term that encompasses a large range of factors, including a broad set of motivational, cognitive and metacognitive variables (e.g., goal-setting, self-monitoring) (Zimmerman, 1989). Researchers have approached understanding of SRL from different perspectives (i.e., Vygotskian, Piagetian, Behaviourist, Constructivist), resulting in numerous definitions of SRL. Despite these, there is consensus that SRL involves a cyclical feedback loop, self-awareness and a value for knowledge about SRL itself (Zimmerman, 2008b).

Unlike Piagetian views that focus on egocentrism or a Vygotskian emphasis on a child's language ability (McCaslin & Hickey, 2008), this thesis will adopt a social-cognitive perspective, recognising that SRL is a complex process (Klug et al., 2011) of planning, monitoring and evaluating learning that is influenced by a range of variables (e.g., cognition, self-efficacy), particularly that of metacognition (Winne & Hadwin, 1998).

Several frameworks attempting to theorise SRL in the context of schools have emerged in the past two decades. Panadero (2017) compared six of the most prominent models available and concluded that they shared some similarities. For example, he stated that most models acknowledged that SRL included "cognitive, metacognitive, behavioural, motivational, and emotional/affective aspects of learning" (Panadero, 2017, p. 1). Perhaps most importantly, he reported that the models of SRL offer useful frameworks for conceptualizing SRL and that researchers can select a model that best aligns with their research aims. This thesis is grounded in thinking about SRL in using Zimmerman's triadic model of SRL (2000, 2002, 2013): *Forethought*, *Performance* and *Self-Reflection*. *Forethought* includes goal setting and strategic planning, *Performance* involves implementation of chosen strategies and a level of self-observation and self-monitoring and *Self-Reflection* involves a self-evaluation of the outcomes. This choice is underpinned by Bandura's (2001) social cognitive theory, but also highlights the importance of metacognition, focuses on self-regulation of learning, is well-represented in recent literature (for example, Bembenutty, White, & Vélez, 2015; Callan & Shim, 2019; Schunk & Greene, 2018) and is easily applied in educational contexts (for example, Cleary, Velardi, & Schnaidman, 2017; Herndon & Bembenutty, 2017). In addition, Dignath, Büttner, and Langfeldt (2008) argued that frameworks grounded in social cognitive learning theory recorded higher effect sizes in schools than other types of frameworks.

Research in the field of SRL continues to be very active, particularly in the past decade. According to Panadero (2017), "SRL has become one of the most important areas of research within educational psychology" (p. 1). It is considered an "essential educational skill" because it not only influences how learners manage their own learning (Schunk & Greene, 2018, p. 13), but also

is considered an “important survival tool” in a rapidly evolving global context (Bjork, Dunlosky, & Kornell, 2013, p. 418). SRL is incorporated in several different 21st century capability frameworks (for example, Binkley et al., 2012; OECD, 2005, 2018; Voogt & Roblin, 2012) and the Alice Springs (Mparntwe) Education Declaration (Education Council, 2019), further emphasising its importance. The Australian Curriculum, Assessment and Reporting Authority (ACARA, 2020) have incorporated goals of enhanced SRL within their focus on developing students’ general capabilities. Key components of SRL, such as self-management, have been positioned under the general capability “personal and social capability”, while other aspects of SRL, such as self-awareness and metacognition, are situated under the general capability “critical and creative thinking capability”. Gonski et al. (2018) urged the Australian Government to “give more prominence to the acquisition of the general capabilities e.g., critical and creative thinking, personal and social capability [sic]” (p. xii), placing greater emphasis on the need to support the development of student SRL in schools. Australian state and territory governments are documenting SRL as a sub-goal under broader goals directed toward life-long learning. For example, “The Future of Education: An ACT education strategy for the next ten years” (ACT Education Directorate, 2018) outlined four foundations for education improvement efforts, the first being positioning students at the centre of learning, further detailing that all students are *active learners* who demonstrate *self-control* as they successfully navigate their own learning journey. In other words, they are self-regulated learners.

Despite these goals, researchers have, for an extended period, reported low levels of adoption of explicit teaching of SRL strategies in regular classrooms, with teachers varying in quantity and quality of such teaching (Dignath-van Ewijk, 2016; Hamman, Berthelot, Saia, & Crowley, 2000; Hattie & Yates, 2014; Spruce & Bol, 2015; Vandevelde, Van Keer, Schellings, & Van Hout-Wolters, 2015). For example, using lesson observations and interviews, Dignath and Büttner (2018) studied teachers’ explicit teaching of SRL strategies in 12 primary and 16 secondary schools, reporting that little explicit strategy instruction occurred in German classrooms. Their findings revealed that primary school teachers did not engage in explicit teaching of SRL strategies, while only one secondary school teacher engaged in explicit strategy instruction, devoting just 2.43 minutes to it. Six of the 16 secondary school teachers were found to briefly discuss the benefits of using a learning strategy with their students (m=1.14 min). Additionally, Dignath and Büttner (2018) documented that teachers seemed to emphasise implicit modelling of cognitive strategies over explicit teaching of motivational, cognitive and metacognitive strategies.

More recently, Dignath-van Ewijk and Veenman (2020) systematically reviewed 17 classroom observation studies that examined how teachers promote SRL, reporting that “in most classrooms, only little direct strategy instruction took place” (p. 1). The review highlighted the need for “(1)

instructing SRL strategies explicitly so that students develop metacognitive knowledge and skills to integrate the application of these strategies successfully into their learning process, and (2) the necessity of complementing classroom observation research with data gathered from student and teacher self-report in order to obtain a comprehensive view of the effectiveness of teacher approaches to support SRL [sic]" (Dignath-van Ewijk & Veenman, 2020, p. 1). As an aside, these studies were from Belgium, Canada, Germany, Hong Kong, USA, Switzerland and The Netherlands, further highlighting a potential lack of classroom observation studies about SRL in the Australian context.

Given that SRL is highly placed on local and global agendas, it is clearly an important educational focus to study. Unfortunately, school improvement initiatives concerning SRL reflect the nature of typical school improvement initiatives: ambitious goals, but little evidence of becoming embedded within the school beyond initial funding and start-up phase. While studies have begun to consider "determinants" of SRL implementation (for example, De Smul, Heirweg, Devos, & Van Keer, 2018; Heirweg et al., 2020), no study was found in the context of SRL that sufficiently conceptualised schools as Complex Adaptive Systems with sustainability as an ongoing process of school improvement.

1.6. Rationale for the Present Study

To summarise, based on an exploration of extant literature earlier in this chapter, there are significant reasons to justify the present study, as there is a need to:

- Conceive of schools as Complex Adaptive Systems, with sustainability as an emergent property of the system (Sections 1.1 and 1.2).
- Focus on school middle-leaders (Section 1.3).
- Deeply explore epistemic cognition for teaching (Section 1.4).
- Attend to the domain of SRL (Section 1.5).

In this section, the contribution of the present study to a range of different fields is stated, from two different perspectives: theoretical and methodological.

From a theoretical perspective, this study conceptualises schools as Complex Adaptive Systems and defines sustainability (Koh & Askell-Williams, 2020) in the context of SRL. Within this conceptualisation of sustainability, the study responds to a call to action espoused by researchers for further research into the various factors that influence the sustainability of school improvement initiatives about SRL (for example, Heirweg et al., 2020). By studying emergent, unpredictable and potentially impermanent properties of the continuous, dynamic and non-linear process of

improvement of schools, it progresses understanding of factors that influence sustainability of school improvement initiatives about SRL. Most importantly, this thesis theorises a process of epistemic cognition for teaching about SRL, along with sub-process of epistemic reflexivity about teaching for SRL, an important step forward in understanding the decision points that lead to changes in teaching practice about SRL.

Furthermore, this study adds to the scarce literature about school middle-leaders (De Nobile, 2018a; Harris et al., 2019) by focusing on emergent changes in school middle-leaders' epistemic cognition as they participated in an upgraded PLC that combined conceptual change perspectives (Vosniadou et al., 2020) and explicit prompting of epistemic reflexivity (PLC-ER about SRL, discussed in section 2.5). The study also addresses concerns raised by researchers (for example, Dogan, Pringle, & Mesa, 2016; Gaikhorst et al., 2017; Vescio, Ross, & Adams, 2008) who noted that published PLC studies failed to provide adequate detail of PLC characteristics and effects of PLCs on different participant groups. Lastly, the study moved beyond isolated beliefs to consider a broader system of beliefs (Vosniadou et al., 2020) – epistemic cognition – contributing to this emerging field of research about epistemic cognition for teaching (Barnes et al., 2020; Fives et al., 2017; Lunn Brownlee et al., 2017), specifically in the highly topical context of SRL.

From a methodological perspective, the present study makes a sizeable contribution to the field of sustainability of school improvement initiatives about SRL. Koh and Askell-Williams (2020) pointed out that most studies included in their scoping review "reported a snapshot or retrospective description of implementation, challenges and what was done to address those challenges" (p. 26). This study goes beyond snapshot data to report microgenetic changes in school middle-leaders' epistemic cognition for teaching about SRL and how their epistemic cognition influences the emergent product of sustainability. Additionally, many past studies have relied solely on self-report questionnaires (Thomas, Peeters, De Backer, & Lombaerts, 2020; Vosniadou et al., 2020) with many of these researchers acknowledging the sole reliance on self-report methods to be a substantial limitation of their work and advocating for more diverse approaches. To overcome this limitation, in this study self-report questionnaires were complemented with self-report process measures of thinking-aloud and non-self-report lesson observations. Furthermore, in their review of classroom observation studies, Dignath-van Ewijk and Veenman (2020) reported that "most [observational] studies [of teachers' SRL practices] included only single lessons" (p. 14), with a mere single study (Depaepe, De Corte, & Verschaffel, 2010) conducting weekly observations of two Year 6 classrooms over 7 months. In this study, a microgenetic approach (detailed at 3.1.2) was used that included 75 lesson observations of each participating middle-leader during a 12-week time-period, with a follow up lesson observation 9 months after the conclusion of the professional education program.

1.7. Broad Research Aims

In an effort to better understand sustainability of school improvement initiatives about SRL, the present study had the following broad research aims:

- To generate a framework of epistemic cognition for teaching in the context of SRL.
- To establish the current quality of school middle-leaders' epistemic cognition for teaching and teaching practice about SRL (that is, a baseline).
- To design, implement and evaluate an approach to professional education that might enhance middle-leaders' epistemic cognition for teaching, specifically in the context of SRL, ultimately to support student SRL.
- To investigate any emergent changes (or downstream effects) that occurred with teachers and students, when a researcher-facilitated professional education program about SRL is introduced for school middle-leaders.

1.8. Thesis Outline

This thesis is arranged in eleven chapters, structured as for the Journal Article Reporting Standards (JARS) recommended by the American Psychological Association (2020).

This first chapter has offered a broad context and rationale for the study. It provided an overview of the study's key aims and overarching concepts (e.g., middle-leadership, epistemic cognition for teaching, SRL). Chapter 2 is a *literature review* about middle-leadership with a particularly focus on the teaching component of such roles, epistemic cognition for teaching, and methods to promote high-quality epistemic cognition. Chapter 3 documents the *method,* including research design, study participants, professional development intervention and approach to data collection and analysis. Chapters 4 through 8 outline *results* and *discussion* using different data representations. Chapter 9 presents *limitations* and *future research directions.* Chapter 10 provides *conclusions, recommendations and implications*. Lastly, Chapter 11 is a brief *concluding statement*. *References* and *Appendices* are included following the final chapter.

2. LITERATURE REVIEW

This chapter reviews literature about middle-leaders, emphasising the importance of their epistemic cognition for teaching, particularly within the context of SRL.

Section 2.1 explores the complexity of middle-leaders' roles and highlights a primary function of middle-leadership is to develop teachers' professional competence, thereby requiring middle-leaders' to be professionally competent themselves. Section 2.2 considers an expanded model of epistemic cognition for teaching and with detail on each component within the model. Section 2.3 discusses how teacher knowledge and beliefs are positioned as the foundation on which epistemic cognition occurs and considers what high quality means for each component in the context of teaching about SRL. The broader process of epistemic cognition for teaching is considered in Section 2.4, leading to Section 2.5, which discusses the role of epistemic reflexivity for teaching, and offers a new process framework of epistemic reflexivity for teaching. Section 2.6 proposes that a professional learning community that promotes epistemic reflexivity has potential to improve the quality of epistemic cognition for teaching about SRL. Quality of epistemic cognition for teaching about SRL is evaluated in Section 2.7 against a set of evidence-informed quality dimensions. Section 2.8 contains the aim of this research, and considers research questions, hypothesis and associated variables.

2.1. Middle-leaders

In Chapter 1, I argued that middle-leaders are a "bridge and broker" between senior leadership and regular classroom teachers. To clarify, in this thesis, I am not attending to senior leaders (e.g., Principals) who provide the nexus between a school's board/government leaders and school staff. My focus is on the middle-leaders that function between principals and teachers, namely, the school's subject or year level curriculum leaders (e.g., heads of department, curriculum leaders, subject co-ordinators).

2.1.1. A complex role, including staff development

Middle-leaders play an important role in the uptake of school improvement initiatives (Harris & Jones, 2010; Lipscombe, Tindall-Ford, & Grootenboer, 2020). Leithwood (2016) stated that "department heads are an underutilized, if not untapped, source of instructional leadership, the type of leadership critical to… school improvement" (p. 117). The influence of the middle-leader role is largely determined by their location on a school's organisational chart. Often, senior leaders are too far removed from the classroom to directly influence teaching and learning in the classroom. Middle-leaders, on the other hand, due to their dual role of leading and teaching, are

much better placed to influence teaching and learning (Grootenboer, 2018; Lipscombe et al., 2020). However, given the locality of middle-leaders' positions between senior leadership and teaching staff, the role of middle-leadership is inherently complex. To help capture some of the complexity of middle-leadership, multiple reviews have occurred in the field of school middle leadership. For example, Bennett et al. (2007) conducted two reviews of empirical research about middle-leadership. They reported that middle-leaders were expected to be a supervisor/line-manager and to also create a supportive culture for teacher professional growth. This further emphasises the complexity associated with the middle-leaders' location on a school's organisational chart. Leithwood (2016), in his review of 42 empirical studies produced a long list of effective department head leadership practices (i.e., middle-leaders' practices), including, developing a shared vision, working collaboratively with teachers, creating a culture of growth and improving instructional practice. More recently, De Nobile (2018b) conducted an extensive review of the literature, and proposed the Middle Leadership in Schools model – a model that explores influencing variables on middle-leadership. The Middle Leadership in Schools model includes six middle-leader role categories, namely, student focussed (dealing with student issues), administrative (process improvement), organisational (e.g., managing duty rosters/timetables), supervisory (evaluating staff performance), staff development (building the capacity of staff members) and strategic (setting goals and a vision).

There is consensus in the literature that one prominent function of the middle-leader role is to support teachers in the enhancement of their professional practices (Bennett et al., 2007; De Nobile, 2018b; Leithwood, 2016; Lipscombe et al., 2020), for example, coaching and mentoring (Brundrett & Duncan, 2010; Danielson, 2007; Fleming, 2014). Lipscombe et al. (2020) suggested that middle-leaders can "support teacher ownership of site-based projects" (p. 1063) and engage in professional learning communities. Liljenberg (2016) advocated that a pedagogical leader, such as a middle-leader, would also be required to provide explicit advice to struggling or novice teachers. Furthermore, middle-leaders can foster high-quality teaching practice by leading by example (Heng & Marsh, 2009; Youngs, 2014). It is the middle-leaders' function for teacher development that is most pertinent to the present study. Given the status of SRL teaching initiatives in schools, and that studies continue to raise concerns about the quality of teachers' professional competence for teaching SRL, middle-leaders offer a potential avenue to achieve improved teaching practice about SRL.

2.1.2. Expertise influences staff development

If middle-leaders are to positively influence teachers' instructional practices then the middle-leaders need to be professionally competent in their own teaching. Hirsh and Bergmo-

Prvulovic (2019) articulated the assumption well - “those who still have a practical foundation in the activities they are intended to lead will have a direct and positive impact on practice (p. 352). Many researchers allude to this in their writing. For example, Bennett et al. (2007) referred to this as being a ‘leading professional’, demonstrating high levels of teaching expertise in their subject domain and modelling this practice for their departmental colleagues. Leithwood (2016), listed that department heads (i.e., middle-leaders) have “extensive pedagogical content knowledge” and “models what it means to be an ‘expert-practitioner’” (p. 128-130). Grootenboer (2018) indicated that middle-leaders are required to draw on their teaching and learning expertise to support the professional learning of their teachers and ultimately improve student learning outcomes. Lipscombe et al. (2020) stated that “middle-leaders are arguably highly experienced teachers” (p. 1065). These statements of practitioner ‘expertise’ suggest that middle-leaders are also competent in their teaching, including the teaching of general skills that underpin their disciplines such as SRL… *but are they?*

Bennett et al. (2007) highlighted that lacking professional knowledge, skill or confidence in a particular teaching situation (e.g., SRL) “can create situations of uncertainty in which subject leaders [i.e., middle-leaders] may feel able to intervene” (p. 459). For example, middle-leaders lacking competence, may doubt their ability or lack confidence to support others effectively (Bennett et al., 2007; Gurr, 2022). This has flow on effects for middle-leaders’ engagement in classroom observation and feedback cycles (Leithwood, 2016), mentoring (Fleming, 2014), or modelling practice (Heng & Marsh, 2009; Youngs, 2014). Personal factors such as knowledge and beliefs have been argued to reciprocally determine behaviour (Bandura, 2001, 2019). Therefore, if a middle-leader does not possess the relevant knowledge or skill then there are a number of leadership practices the middle-leader may be unable to fulfil.

From the above review, it is evident that middle-leaders’ expertise as teachers (knowledge, beliefs and practice) provides a foundation that influences the quality of their instructional leadership and the uptake of school improvement initiatives focussed on teaching and learning. Therefore, in the context of school improvement initiatives about SRL, I begin my research program by focussing on middle-leaders’ knowledge, beliefs and practice about SRL in their own classrooms.

However, this thesis approaches middle-leaders’ knowledge, beliefs and practice from a new perspective. Recently, researchers have theorised that teachers’ epistemic cognition – how a teacher thinks about different bodies of knowledge (e.g., SRL) – plays a substantial role in informing their teaching practice. Thus, a fruitful avenue of enquiry about middle-leaders’ capabilities for addressing both the teaching and teaching-leadership aspects of their roles would

be to investigate their epistemic cognition for teaching. Accordingly, in the following sections I review literature about teachers' epistemic cognition.

2.2. Epistemic Cognition for Teaching about SRL

As mentioned in Chapter 1, epistemic cognition for teaching is still very early in its development. This section reviews research of models of epistemic cognition for teaching (Section 2.2.1) and the quality of teacher epistemic cognition for teaching about SRL (Section 2.2.2). Section 2.2.1 includes a proposed model of epistemic cognition for teaching.

2.2.1. Models of epistemic cognition for teaching

There have been a number of models in the area of epistemic cognition for teaching. Building on research about learners' epistemic cognition and the field of research about teachers' knowledge and beliefs (for example, Buehl & Fives, 2016; Chinn et al., 2011; Chinn, Rinehart, & Buckland, 2014), Fives et al. (2017) proposed a *model of epistemic cognition in teaching*. This model suggested that epistemic cognition in teaching exists within a context of a teaching task and the teacher's relevant domain of knowledge and further that the process of epistemic cognition is an interplay between the following components:

- *Epistemic aims,* that is, knowledge-focused goals.
- *Teachers' self-system*, including prior knowledge, epistemic ideals/stances (i.e., the criteria used to evaluate knowledge), epistemic vices/virtues (e.g., intellectual virtues) and epistemic value (i.e., value placed on different domains/types of knowledge), which can be broadly referred to as "Teachers' knowledge and beliefs".
- Iterative processes of consideration and evaluation of *epistemic matters* (e.g., thinking about knowledge and knowing) and selection and use of *reliable processes* (e.g., selecting strategies/methods to reliably develop/construct accurate knowledge).

For Fives et al. (2017), the result of teachers' epistemic cognition was the enacted teaching practice (that they termed *epistemically informed praxis*) to achieve already-set epistemic aims. Their model appeared to be the first explicitly to position epistemic cognition within teachers' pedagogical decision making and the wider teaching context.

Drawing on Bandura's (1997) model of reciprocal determinism, Zimmerman's (2002) triadic model of self-regulated learning and models of epistemic cognition for learning and teaching (for example, Chinn et al., 2014; Fives et al., 2017), Barr and Askell-Williams (2020a) postulated that epistemic cognition for teaching is a process consisting of three phases: *Forethought*, *Performance* and *Self-Reflection*. During the *Forethought* phase, teachers set epistemic aims and

select reliable processes, then, they perform the reliable processes (*Performance* phase) and lastly, they assess whether the epistemic aims were achieved (*Self-Reflection* phase). Barr and Askell-Williams applied their model in a teacher professional education setting and demonstrated that it was a starting point to conceive teachers' epistemic cognition about SRL.

Building on this last model, an updated model of epistemic cognition for teaching is presented in Figure 2.1..

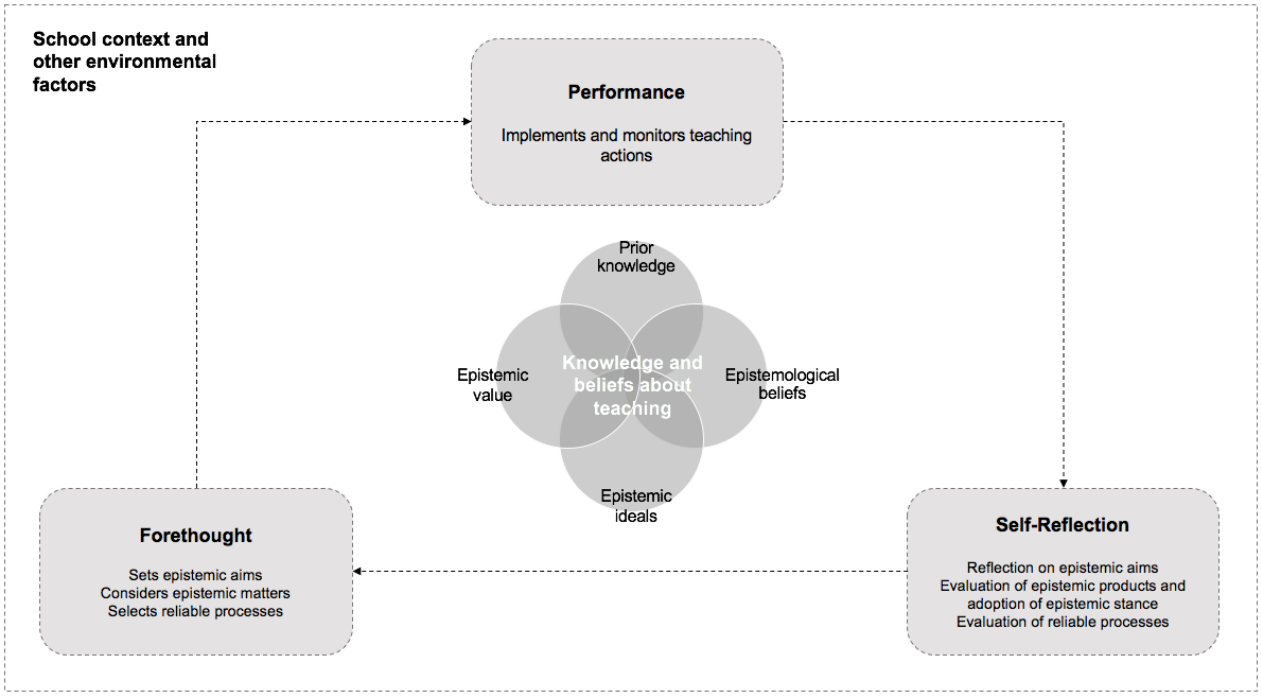

Figure 2.1. Model of epistemic cognition for teaching

The model of epistemic cognition for teaching involves *knowledge and beliefs about teaching,* shown in the Venn diagram in the middle of Figure 2.1. *Knowledge and beliefs* comprise a range of factors, including prior knowledge, epistemic beliefs, epistemic ideals and epistemic value. The personal factors listed within *knowledge and beliefs about teaching* in Figure 2.1. are not a definitive list. In the literature about teachers' beliefs about teaching, other internal factors also qualified, such as self-efficacy (De Smul et al., 2018) and expectancy beliefs (Yan, 2017). As Schommer-Aikins (2002) stated "personal epistemology is composed of more than one belief. (Neither four nor five beliefs are considered a sacred number…)" (p. 106). However, I have focused on beliefs that are predominantly epistemic in nature and most pertinent to epistemic cognition for teaching.

In Figure 2.1, *knowledge and beliefs about teaching* for teachers interact with the process of epistemic cognition, a cyclical process in which, a teacher moves through a *Forethought* phase (setting epistemic aims and selecting reliable processes), a Performance phase (enacting chosen

reliable processes) and finally, a Self-Reflection phase (reflecting and evaluating epistemic products that result from the process).

In addition, teacher *knowledge and beliefs about teaching* and engagement in the three process phases (*Forethought, Performance and Self-Reflection)* is influenced by the *school context and other environmental factors* (for example, leadership, school policies), represented in Figure 2.1. as the surrounding box. This is an important acknowledgement in the process of epistemic cognition – that epistemic cognition is reciprocally determined by the environment in which the teacher operates. For example, the school policies can influence how a teacher thinks about knowledge and knowing, and likewise, the action a teacher takes can influence policy. Dotted lines in Figure 2.1. represent the interplay between each component – information passing across loose boundaries – analogous to a cell's semi-permeable membrane.

2.2.2. Quality of teacher epistemic cognition for teaching about SRL

Sustainability of school improvement initiatives about SRL requires teachers, and school middle-leaders to engage in high quality epistemic cognition for teaching about SRL (refer Chapter 1). Chinn and Rinehart (2016) argued that "sophisticated epistemic cognition entails deep and extensive knowledge of the various causal processes used to produce knowledge and other epistemic products" (p. 471). Building on Chinn and Rinehart's earlier work, Barzilai and Chinn (2018) explained that high quality epistemic cognition, which they termed *apt epistemic performance*, "involves the ability to identify epistemically valuable products in a particular task or field, such as the important problems or questions or the most valuable knowledge for solving a problem" (p. 367). In the context of teaching about SRL, high quality epistemic cognition for teaching would arguably require sound foundations of knowledge and epistemic beliefs about SRL, and the competent ability to engage in the process of epistemic cognition (i.e., forethought, performance and self-reflection).

In a discussion about the challenges of a "post-truth" period, Chinn, Barzilai, and Duncan (2020) stated that "an apt response to deep epistemic disagreements [or agreements] requires *that people develop individual and collective abilities to make epistemic assumptions visible, to justify and negotiate these assumptions, and to develop shared commitments to appropriate standards and processes of reasoning*" (p. 167, emphasis added). This same argument can be applied in the context of educators teaching for SRL. Without high quality epistemic cognition, educators are unable to engage in an "apt response" (Chinn et al., 2020, p. 167). Thus, school improvement initiatives, particularly those in the form of professional education for teachers, should endeavour to make epistemic beliefs explicit, and work toward high quality knowledge and

beliefs about the chosen domain (e.g., SRL), and to develop appropriate epistemic aims and reliable processes for enacting and evaluating claims.

Numerous studies have reported on isolated aspects of teachers' epistemic cognition for teaching about SRL. For example, researchers detailed that teachers' beliefs about SRL influence their teaching practice *about SRL* (Kistner, Otto, Büttner, Rakoczy, & Klieme, 2015) and that teachers may possess low quality knowledge and beliefs about SRL (Dignath-van Ewijk & van der Werf, 2012; N. E. Perry, Hutchinson, & Thauberger, 2008; Spruce & Bol, 2015). Dignath and Büttner (2018) documented that primary and secondary school mathematics teachers lacked knowledge about SRL, particularly its metacognitive component, in their interview and lesson observation study. Callan and Shim (2019), in a study exploring how 128 K-12 teachers defined SRL, reported that teachers often described SRL as self-directed learning as opposed to Zimmerman's cyclical process of forethought, performance and self-reflection (Zimmerman, 2002). Additionally, in earlier work with science teachers, Barr and Askell-Williams (2020a) reported that the quality of teachers' knowledge and beliefs about SRL were far from optimal and questioned how teachers could engage in effective epistemic cognition about SRL if they didn't know what knowledge goals could be set or what suitable processes were available to achieve such knowledge goals.

There is consensus among educational researchers that, to promote students' SRL in the classroom effectively, teachers require high quality knowledge about both SRL (Askell-Williams & Lawson, 2005; Lawson, Vosniadou, Van Deur, Wyra, & Jeffries, 2018; Spruce & Bol, 2015) and the epistemic beliefs that support SRL (Chinn et al., 2011; Dignath & Büttner, 2018; Dignath-van Ewijk & van der Werf, 2012; Vosniadou et al., 2020). Callan and Shim (2019) captured this well in saying "the first step for teachers to be efficacious in teaching…SRL in their classroom(s) is to have clear understandings of what constitutes SRL" (p. 295). Barr and Askell-Williams (2020a) argued that teachers' knowledge and beliefs about teaching are the foundations on which teachers' epistemic cognition for teaching occurs. Therefore, it seems paramount that teachers must possess high quality knowledge and beliefs *before* they can engage in high quality epistemic cognition for teaching about SRL.

2.3. Teacher Knowledge and Beliefs for Teaching about SRL

Knowledge and beliefs for teaching form a complex and integrated internal sub-system for teachers that influences their decisions and actions about teaching and learning (Fives & Buehl, 2012). Lawson et al. (2018) defined this sub-system as "a constantly evolving structure that covers a domain of knowledge and is activated, depending on the context, to interpret incoming

information" (p. 230). The sub-system embodies personal factors that reciprocally determine a person's environment and behaviour.

Drawing on previous conceptualisations of this internal sub-system (for example, Bandura, 1978; Fives et al., 2017), teachers' knowledge and beliefs for teaching about SRL is conceived as a network of interrelating internal factors specifically related to their epistemic cognition for teaching about SRL. It is acknowledged that teachers' knowledge and beliefs about teaching for SRL are highly complex and include a broad range of epistemic factors. Within the scope of this study, I have focussed on factors that are established in the literature and arguably influence teaching about SRL, that is: knowledge about SRL (Kistner et al., 2015), epistemic beliefs about SRL (Dignath-van Ewijk, 2016), epistemic ideals (Chinn et al., 2014) about SRL and epistemic value for SRL (Eccles & Wigfield, 2002).

2.3.1. Teachers' knowledge for teaching about SRL

Knowledge refers to mental representations that exists in memory. Views of knowledge have developed over time (Alexander, Schallert, & Hare, 1991; Greene et al., 2016), including the knowledge required for teaching. Shulman (1987) produced the following categories of teacher knowledge: content knowledge; general pedagogical knowledge; curriculum knowledge; pedagogical content knowledge; knowledge of learners and their characteristics; knowledge of educational contexts; and, knowledge of educational ends, purposes and values.

Models of teacher knowledge typically have not clearly included knowledge for teaching about SRL (for example, Adoniou, 2015; AITSL, 2020; Darling-Hammond, 2006). To rectify this, Lawson, Askell-Williams, and Murray-Harvey (2009) suggested a new category, "knowledge of learning" that incorporates SRL, be added to Shulman's (1987) original set of categories . Dignath-van Ewijk and van der Werf (2012), also drawing on Shulman's categories, proposed that teacher prior knowledge about SRL be considered primarily through the categories of content knowledge (that is, *what* a teacher teaches – concepts, theories and evidence), pedagogical (that is, *knowing how* to teach in a general sense), knowledge and pedagogical content knowledge (*knowing how to* teach a subject, e.g., SRL).

In considering teacher knowledge, Shulman's categories offer a useful lens for conceiving for teaching about SRL. In accordance with the view of Dignath-van Ewijk and van der Werf (2012), I conceive of SRL as its own domain of knowledge (like Geography or English) and have focussed on the content knowledge and pedagogical content knowledge of teachers about SRL.

Teacher content knowledge

Teacher content knowledge related to the explicit teaching of SRL strategies incorporates declarative, procedural and conditional knowledge ("what", "how", "when" and "why") of SRL strategies. In other words, teachers possessing high quality content knowledge about SRL would know the various motivational, cognitive and metacognitive strategies, the structure and function of each strategy, when to use each strategy and the justification for such use. Additionally, teachers would conceive of SRL as a process (Klug et al., 2011) occurring over three phases of planning, monitoring and evaluating (Zimmerman, 2002) (see Section 2.1).

Teacher pedagogical content knowledge

Teacher pedagogical content knowledge related to the explicit teaching of SRL strategies includes knowledge of how to teach and to assess student knowledge about SRL strategies. Dignath-van Ewijk and van der Werf (2012) defined pedagogical content knowledge as "how teachers *transfer* a specific subject matter to their students" (p. 3, emphasis added).

Transfer is often associated with a transmissive stance and may contradict the constructivist philosophy often associated with SRL (discussed in Section 2.3.2). To mitigate this potential misunderstanding, teacher pedagogical content knowledge about SRL is conceptualised in this study as knowledge of teaching strategies to promote the development of student knowledge about SRL. For example, when teaching for SRL, a teacher with high-quality pedagogical content knowledge about SRL would know the process of explicitly teaching SRL strategies: the teacher could name the strategy, explain the structure and function of the strategy, model its use and then provide students opportunities to practice the strategy themselves (Kistner et al., 2015; Pressley, Harris, & Marks, 1992). The teacher would also know suitable teaching strategies to assess student SRL knowledge, such as a worksheet with metacognitive prompts for SRL, in order both to engage students in the process of SRL (using SRL strategies) and to gather information about their SRL knowledge (Askell-Williams, Lawson, & Skrzypiec, 2012; Gutierrez & Schraw, 2015). Additionally, when assessing student SRL, a teacher with high-quality pedagogical content knowledge about SRL would know that different learning strategies questionnaires (for example, Metacognitive Awareness Inventory, Schraw & Dennison, 1994) can be used to collect data on student knowledge of SRL strategies.

2.3.2. Teacher epistemic beliefs about SRL

Epistemic beliefs are beliefs about the nature of knowledge and knowing (i.e., personal epistemology, sometimes referred to as epistemological beliefs). Such beliefs have long been a topic of interest to researchers. Early researchers conceptualised that knowledge was developed through stages (for example, W. G. Perry, 1970; Piaget & Cook, 1952) - a belief that knowledge is

formed in a stage-like manner. Others advocated that knowledge was socially constructed (for example, Bruner, 1964; Vygotsky, 1962) – a belief that knowledge is formed through social dialogue, interactions and processes.

In a prominent questionnaire study of 117 junior college students and 149 undergraduate students, Schommer (1990) conducted a factor analysis of questionnaire data and proposed a scheme of four semi-independent epistemic beliefs: innate ability, simple knowledge, quick learning and certain knowledge. *Innate ability* was the belief that individuals were genetically predisposed to learning (in other words, SRL). *Simple knowledge* was a belief that knowledge was simple rather than complex. *Quick learning* was the belief that learning only occurred quickly. *Certain knowledge* was the belief that knowledge was fixed and did not change with time. Dignath-van Ewijk (2016), building on Schommer's work, suggested that the dimension of *innate ability* was pertinent to the context of teaching for SRL.

In a seminal comprehensive review of the different research programs about epistemic beliefs including Schommer's scheme, Hofer and Pintrich (1997) proposed a multidimensional framework of epistemic beliefs. They argued that all reviewed models "include[d] content related to [1] the nature of knowledge and [2] the process of knowing" (p. 118) and included four sub-dimensions in their framework, two in the nature of knowledge (certainty of knowledge and simplicity of knowledge) and two in the nature of knowing (source of knowledge and justification for knowing). Hofer (2000) argued that these four sub-dimensions were at the crux of a person's epistemic theory, were "related to each other in coherent and internally consistent ways" (p. 382) and that other aspects of learning existed on the periphery. Hofer and Pintrich's framework was published over 20 years ago, but continues to be highly cited (Chinn et al., 2011; Strømsø & Kammerer, 2016). The current study is grounded in the four sub-dimensions of knowing and knowledge espoused by Hofer and Pintrich (1997), with justification for knowing acknowledged later in this chapter under epistemic ideals. As noted previously, the focus of this study on SRL prompts the addition of the dimension of innate ability (Dignath-van Ewijk, 2016).

The following sub-sections briefly define the sub-categories of epistemic beliefs of teachers about SRL:

- Belief about the source of SRL knowledge.
- Belief that student knowledge about SRL is innate or learned.
- Belief about the certainty of SRL knowledge.
- Belief about the structure (or simplicity) of SRL knowledge.

Belief about source of SRL knowledge

Teachers' beliefs about the source of knowledge exist on a continuum ranging from a belief that knowledge is transmitted from teacher to student (i.e., transmissive beliefs) to a belief that knowledge is personally constructed by the student (i.e., constructivist beliefs).

Researchers (for example, Olafson & Schraw, 2006) have indicated that teachers with transmissive beliefs adopt teacher-centric methodologies, are focused on students achieving a "correct" answer and position themselves as the authority "transmitting" knowledge to the students. Vosniadou et al. (2020), in consideration of pre-service teacher beliefs from a conceptual change perspective (discussed in Section 2.6.1), argued that transmissive beliefs were inconsistent with beliefs that support student strategies for learning.

Teachers with constructivists orientations may believe that students construct knowledge in collaboration with the teacher (i.e., constructivist-supported beliefs) or believe that knowledge is personally and autonomously constructed by the student (i.e., constructivist-autonomous beliefs), in what Olafson and Schraw (2006) referred to as a relativist world view: "self-regulation [is] acquired autonomously" (p. 74). Both constructivist-supported and constructivist-autonomous beliefs are underpinned by a belief that the student is actively involved in construction of his or her own knowledge.

SRL in classrooms is often associated with constructivist beliefs (Kramarski & Michalsky, 2009; Vosniadou et al., 2020), with little clarity as to whether this is constructivist-supported or constructivist-autonomous. For example, in a study of 47 primary school teachers in the Netherlands, Dignath-van Ewijk and van der Werf (2012) reported that teachers associated promotion of SRL with constructivist beliefs. In another study, Kistner et al. (2015) also reported a positive relationship between implicit teaching of strategies and teacher constructivist beliefs. Neither study offered insights into the prevalence of constructivist-supported or constructivist-autonomous beliefs.

Some researchers have suggested that beliefs about the source of SRL knowledge should not be viewed as a firm dichotomy, for example transmissive vs. constructivist beliefs (Olafson & Schraw, 2006) and that teachers may possess multiple beliefs (and sometimes conflicting beliefs) depending on the domain (Buehl & Fives, 2009; Maggioni & Parkinson, 2008). Dignath-van Ewijk and van der Werf (2012) postulated that transmissive beliefs support explicit teaching about SRL (naming, explaining and modelling an SRL strategy), while constructivist beliefs support opportunities to practice SRL strategies in a more autonomous learning environment. Kistner et al. (2015) claimed that teachers with solely constructivist beliefs (most likely constructivist-autonomous) may "perceive [explicit] strategy instruction as a too directive form of

teaching" (p. 191), supporting a dual-belief perspective (transmissive and constructivist). However, this "dual belief" be reconceptualised under the umbrella of constructivist-supported beliefs, rather than a dual belief (transmissive-constructivist). It is of greater benefit to move beyond a dichotomous, dual belief discussion toward a focus on the quality of the constructivist beliefs of teacher. A more pertinent question is "do teachers with constructivist beliefs place value on the role of the teacher in this construction process" (that is, constructivist-supported)? As Barr and Askell-Williams (2020a) argued: "explicitly fostering students' comprehension, transformation, practice and application of SRL strategies requires teachers to believe that students construct their own knowledge" (p. 4).

Belief that student knowledge about SRL is innate or learned

The belief that knowledge about SRL is innate (rather than learned) was essentially a factor generated in Schommer's (1990) analysis, stated as a belief that "the ability to learn is innate rather than acquired" (p. 499). Hofer and Pintrich (1997) argued that Schommer's factor of beliefs about innate ability, referred to as "fixed ability", is drawn from Dweck and Leggett's (1988, p. 256) work, which suggests that individuals possess beliefs about intelligence as either fixed (i.e., entity theory of intelligence) or malleable (i.e., incremental theory of intelligence) and that these beliefs were better positioned under the umbrella of beliefs about intelligence as opposed to epistemic beliefs. Hofer and Pintrich acknowledged that "beliefs about the nature of knowledge and the nature of intelligence or ability may be correlated with one another" (p. 109), but argued that "they are separate constructs" (p. 109).

Dignath-van Ewijk (2016) argued that belief that learning is an innate ability or that it is learned is fundamental to studies focused on the explicit teaching of SRL strategies. Dignath-van Ewijk collected data from 173 primary school teachers about their beliefs about SRL, such as, promotion of SRL, teacher-efficacy and epistemic beliefs. It was revealed by structural equation modelling that teachers who believed that SRL was innate were less likely to promote SRL. Dignath-van Ewijk claimed that this was a logical outcome: if a teacher believes that SRL is an innate ability, then why would he or she engage in the explicit teaching of SRL strategies? More recently, Vosniadou et al. (2020) made a similar argument: the belief that SRL knowledge is innate and therefore unable to be learned is inconsistent with SRL theory.

Belief about certainty of SRL knowledge

Beliefs about the certainty of knowledge can be defined as to whether a teacher views knowledge as fixed (not changing) or tentative (constantly changing) (Hofer, 2000; Schommer-Aikins, 2002). These beliefs are commonly referred to as beliefs about certainty of knowledge (for example, Ferguson & Lunn Brownlee, 2018; Hofer, 2000; Strømsø & Kammerer, 2016). Chinn et al. (2011),

in their Aims, Ideals, Reliable Processes (AIR) framework, suggested that beliefs about certainty of knowledge can also be considered an epistemic stance (for example, “I am certain of my knowledge – it is well justified”). This view is described further in Section 2.4.3. In the remainder the current sub-section, the focus is on a more general understanding of beliefs about the certainty of knowledge.

The evolving nature of knowledge is a principle of scientific thinking (Popper, 2002). Beliefs about certainty are considered foundation to epistemic reasoning (Trautwein & Lüdtke, 2007) or epistemic cognition. Beliefs about the certainty of knowledge are thought to exist on a continuum, with a person’s position on the continuum changing with cognitive development (Hofer, 2000). According to developmental approaches (for example, Hofer, 2000; King & Kitchener, 1994; D. Kuhn & Weinstock, 2002; W. G. Perry, 1970), in the earlier stages of development children are thought to be absolutist, believing that knowledge is fixed and not changing. As individuals mature, they progress towards a belief that knowledge is constantly changing (Hofer, 2000; W. G. Perry, 1970). Recently, in a study of 66 Norwegian primary and secondary school pre-service teachers, Ferguson and Lunn Brownlee (2018) reported that as pre-service teachers progressed in their study, they reported stronger beliefs that knowledge about teaching and learning was constantly changing and therefore tentative. Therefore, teachers, as mature adults, might be expected to believe that knowledge, whether about SRL or other domains, would constantly change. A teacher who believes that SRL knowledge is tentative and evolving has greater alignment with a learning orientation (Dweck, 2012; Dweck & Leggett, 1988) and therefore may be more likely to practically trial and engage in the promotion of student SRL.

Limited studies were found that considered teachers’ beliefs about the certainty of knowledge in the context of SRL. The importance of context was established in Section 1.4 and, as a result, studies that considered teachers’ beliefs about the certainty of knowledge in other domains (for example, teaching; Buehl & Fives, 2009) were not considered. Further, a more open stance to exploring teachers’ beliefs about the certainty of SRL knowledge was adopted.

Beliefs about structure of SRL knowledge

Beliefs about the structure of knowledge, sometimes referred to as “simplicity of knowledge” (for example, Buehl & Fives, 2009; Strømsø & Kammerer, 2016), exist on a continuum from simple to complex (Buehl & Fives, 2009; Hofer, 2000; Schommer, 1990; Strømsø & Kammerer, 2016). For example, Ravindran, Greene, and Debacker (2005), drawing on Schommer-Aikin’s (1994) work, defined beliefs about the structure of knowledge as “to whether an individual believes that knowledge consists of isolated bits and pieces or of interconnected concepts” (p. 223). In the context of teaching about SRL, an educator might believe that knowledge about SRL consists of

separate and distinct facts (e.g., that knowledge about motivation is not connected to knowledge about cognition). In a more complex view, a teacher might believe that knowledge about SRL concepts are strongly interconnected.

More recently, Chinn et al. (2011) argued that structure of knowledge is multidimensional, and includes dimensions of simplicity-complexity, universality-particularity of knowledge and deterministic-stochastic, a position acknowledged by Buehl and Fives (2016). In the present study, I only focus on the simplicity-complexity dimension of beliefs about the structure of knowledge due to limitations inherent with the scope of a PhD study.

Numerous studies have considered pre-service teachers' beliefs about the structure of knowledge, specifically the dimension simplicity-complexity and how this relates to teachers' thinking and practice. For example, Ravindran et al. (2005), in their study of 101 preservice teachers' achievement goals, epistemic beliefs, cognitive engagement and application learning, reported that teachers who believed knowledge was simple engaged in relatively surface-level information processing. When applied to the context of explicit teaching of SRL strategies, it is possible that a teacher who believes that knowledge about SRL is simple may similarly engage in low-level processing about SRL knowledge. As another example, Bondy et al. (2007), in a comparison of case studies, demonstrated that a pre-service teacher who believed knowledge of a subject was complex, engaged in regularly connecting information and reforming their knowledge. In contrast, a pre-service teacher who believed knowledge was simple focused more on the requirements of course assignments. Since high-quality epistemic cognition about SRL involves regular connecting and reforming of knowledge about SRL, Bondy et al.'s study shows that, when applied to practicing teachers, beliefs that SRL knowledge is structurally complex may be required for the adoption of SRL teaching initiatives in schools.

Relationships between epistemic beliefs

Researchers differ in their views about whether the different epistemic beliefs are relatively independent or related. Schommer (1990), in her factor analysis of questionnaire data, reported that factors were "more or less independent" (p. 500). Maggioni and Parkinson (2008) acknowledged this argument by indicating that a set of beliefs that sit under the heading "epistemological beliefs [epistemic beliefs]" are "different, quite stable, semi-independent dimensions" (p. 447). In opposition, Hofer (2000) argued that while her proposed four dimensions are related, one, *justification of knowledge,* drew more heavily on the other three dimensions than the reverse. For example, when an individual engages in a process of justifying knowledge, they draw on their beliefs about the source, structure and certainty of that knowledge in their evaluations. In Chinn et al.'s (2014) AIR model, structure of knowledge and justification of

knowledge, what Hofer and Pintrich (1997) documented as separate categories, are presented in one category due to their shared function: “criteria in both categories are produced as reasons or justifications for claims” (p. 434). Chinn et al. (2014), drawing on the Hofer and Pintrich (1997) model, noted that a person justifying the value of a scientific theory may discuss aspects of its “simplicity and its clear mechanisms [aspects of structure in the Hofer and Pintrich model] or its consistency with a broad scope of empirical data or personal experience [aspects of justification in the Hofer & Pintrich model]” (p. 434). The model of epistemic cognition for teaching proposed in Section 2.2.1 views beliefs as constantly interacting with each other.

2.3.3. Teachers’ epistemic ideals about SRL

Epistemic ideals are criteria an individual uses to evaluate and justify the quality of their knowledge and to determine whether they have achieved their aims (Chinn et al., 2011). Epistemic ideals relate to Hofer and Pintrich’s (1997) epistemic belief category of *justification for knowing*, but stem from prior knowledge and beliefs about source, structure and certainty of knowledge (Weinstock et al., 2017). Therefore, although epistemic ideals could arguably sit under an umbrella of epistemic beliefs, I have separated in my model of epistemic cognition for teaching (refer Figure 2.1.) to acknowledge the difference between more commonly understood epistemic beliefs, as those described earlier in Section 2.3.2. More broadly, epistemic ideals can be understood as reflecting a person’s perspectives on the parameters of knowledge (Fives et al., 2017).

Interest in a person’s epistemic ideals can be traced back to the mid-1900s (for example, Gettier, 1963). Researchers adopting a developmental perspective (for example, King & Kitchener, 1994; King & Kitchener, 2004) proposed that individuals move from relying on methods of observation and unfounded personal opinions to methods of inquiry and consistent engagement with multiple sources of evidence to justify their knowledge claims. Recently, Chinn et al. (2014) coined the term “epistemic ideals” as an extension of scientists’ explanatory ideals. They postulated that scientists’ explanatory ideals (i.e., fit with evidence, fit with other theories) were criteria used to evaluate a good explanation, and documented explanatory ideals as: explains a broad scope of evidence, is not contradicted by significant evidence, is fruitful for future research, is internally consistent, coheres with other, accepted scientific explanations and in some fields, specifies a causal mechanism. Extending this conception to epistemic products beyond an explanation (e.g., knowledge, understanding, models), Chinn et al. (2014) detailed epistemic ideals as:

- internal structure.
- connections to other knowledge.

- present and future connections to empirical evidence.
- quality of source.
- quality of communication.

In my search of the literature about epistemic cognition for teaching about SRL, I was unable to find much detailed information specifically about educators' epistemic ideals about SRL to answer the questions: *How do teachers know that a student is engaged in high quality SRL?* and *What are the criteria or indicators that they use?* However, it is possible to apply Chinn et al.'s (2014) proposed epistemic ideals when students' knowledge about SRL strategies manifests itself as an explanation. For example, if a teacher asked a student to explain how they self-regulate their learning, the student might provide an explanation that can be evaluated against Chinn et al.'s proposed epistemic ideals (e.g., internal structure, connections to other knowledge). However, in a normal classroom context, students' knowledge about SRL is not necessarily communicated as an explanation, but can manifest itself in other various ways (e.g., students' behaviour). Chinn et al. (2014) referred to this contextual factor as "situational variation" (p. 434), suggesting that individuals possess and use different epistemic ideals depending on the context. Chinn and Rinehart (2016) expanded this, claiming that differences may exist in the epistemic ideals of "individuals, age groups, social groups, and cultures" (p. 469) and in different subject matter. As a group, teachers are different to scientists and, as a domain of knowledge, SRL is different in content from others (e.g., science), so epistemic ideals will inevitably be different. An implication of the research of Chinn et al. (2014) is that variations in application of epistemic ideals across different contexts should be explored, along with the processes that underlie such variations.

In Kuhn's (2001) exploration of how people know (i.e., their epistemic ideals), she asked, "When I claim something is the case, how do I know? What justification do I regard as sufficient to warrant my making the claim and sufficient to demonstrate its correctness if I am asked to do so? (p. 1). Kuhn's questions can be adapted to the context of SRL, namely, when the teacher claims that a student is engaged in SRL or has achieved a deeper knowledge about SRL strategies, how do they know? What justification do they regard as sufficient to warrant them making the claim and sufficient to demonstrate its correctness?

Guided by Chinn et al.'s (2014) proposed epistemic ideals, the extant literature about SRL and Kuhn's questions, I offer five categories of epistemic ideals that teachers might use to evaluate and justify their own knowledge about students' knowledge about SRL strategies. These are shown in Table 2.1. In the table, an asterisk ("*") denotes that SRL knowledge refers to information communicated verbally or inferred from observation (that is, enacted knowledge).

Table 2.1. Proposed teacher epistemic ideals in context of explicit teaching of SRL strategies

Proposed epistemic ideal	Explanation of proposed epistemic ideal about SRL	Supporting theory
1. SRL knowledge* is internally consistent and sufficiently complex Example: articulated knowledge is internally consistent	Relates to the 'internal consistency' of the student knowledge about SRL. This ideal may only be present in an 'explanation'. In the case of an explanation, the pieces of knowledge are highly related and suitably complex.	Chinn et al. (2014) category of 'internal structure'
2. SRL knowledge* coheres with the available evidence-base Example, does the knowledge reflect the extant literature?	Relates to whether the knowledge or observed behaviour coheres with the research evidence about SRL. For example, a teacher may observe a student implementing a self-monitoring strategy and connect this with the monitoring/performance phase of SRL.	Chinn et al. (2014) category of 'connections to other knowledge' and 'present and future connections to empirical evidence Ideals also include awareness of competing viewpoints (Kuhn & Weinstock, 2002; Barzilai & Chinn, 2018)
3. Source of knowledge* Examples: age of student, general capability of student	Relates to the source itself. Drawing on developmental theories, students typically develop their ability to self-regulate as they progress through school. A teacher may evaluate students' SRL based on their age (for example, older students more likely engage in SRL). If a teacher believes that the student is highly capable based on past experience, this may also be used to justify the student's SRL performance.	Chinn et al. (2014) category of 'quality of source
4. SRL knowledge* is clearly communicated from student to teacher Example: behaviour is clearly visible or knowledge about SRL is clearly communicated	Relates to how clearly the knowledge and or behaviour is received or observed. For example, a teacher may see a student staring at something blankly and be unsure whether the student is engaged in a form of self-reflection or merely day-dreaming.	Chinn et al. (2014) category of 'quality of communication
5. Reliable process used to gather information about SRL knowledge* Examples: SRL process protocol, Metacognitive Awareness Inventory	Relates to the quality of the processes used the gather information about students' SRL knowledge. For example, if a teacher believed observation of student behaviour was a reliable process and had implemented this to collect information (and develop knowledge) about their students' SRL, then they may deem their new-found knowledge as justified, because of the reliable process adopted.	Chinn & Rinehart (2016) suggested that reliable processes can be used as epistemic ideals

In Table 2.1, if a teacher claimed that a student was engaged in SRL and was asked to justify this, the teacher may offer an explanation that is consistent with some or all the proposed epistemic ideals about SRL. As a more detailed example, a teacher might observe a senior student demonstrate a self-evaluation strategy (enacted knowledge about SRL strategies). The clear identification of the behaviour alone suggests a level of *internal consistency* (epistemic ideal 1) in the behaviour, and that the behaviour was *clearly communicated* (epistemic ideal 4) and received by the teacher. The teacher is certain that this student is engaged in SRL as she is expected to be self-regulating her learning at her age (*source of knowledge – epistemic ideal 3*), and the self-evaluation strategy falls within the third phase of Zimmerman's triadic model of SRL described in Section 2.2.1 (*coheres with evidence – epistemic ideal 2*). Additionally, the teacher believes that observation of student SRL behaviour (e.g., enacting knowledge about SRL strategies) is a *reliable process* for gathering information about students' SRL (*epistemic ideal 5*).

The body of literature about teachers' epistemic ideals about SRL is sparse, and I only found one study (Callan & Shim, 2019), which investigated 128 K-12 teachers' epistemic ideals about SRL. Callan and Shim (2019) asked teachers to describe their epistemic ideals for SRL (e.g., "if a student in your classroom is not a self-regulated learner, how do you know?" [p. 301]), specifically focusing on when students were <u>not</u> engaged in SRL (were not enacting/demonstrating knowledge of SRL strategies). Teachers' epistemic ideals included observations of student behaviour as opposed to other reliable processes for collecting information about students' SRL capabilities (e.g., SRL Process Protocols, Questionnaires).

> Forty-six percent of the responses provided pointed to the lack of motivation and 35.7% mentioned the lack of self-control processes. Many teachers also indicated academic underachievement or disengagement. For example, many teachers (54%) stated that off- task behaviors [sic] were indicative of deficient SRL (e.g., "disengaged, zero to poor work ethic, lack of focus, disruptive"). Some teachers (33.33%) identified unacceptable or late work as an indicator of the absence of SRL skills (e.g., "work quality is poor") and 28.6% of teachers indicated poor achievement or learning (e.g., "poor performance" or "does not know the material"). (Callan & Shim, 2019, p. 303)

Results revealed that teachers varied in their epistemic ideals for identifying deficient SRL, with most responses focusing on "maladaptive classroom behaviours/outcomes (e.g., off task, poor work completion)" (p. 295), with only a few responses clearly referencing a specific aspect of the SRL process (e.g., Forethought, goal setting, task analysis).

2.3.4. Teachers' epistemic value for knowledge about SRL

According to Chinn et al. (2011), epistemic value denotes "the worth" of different epistemic products (p. 142). Drawing on philosophical practices, Chinn et al. (2014) advocated that researchers consider epistemic value against the spectrum of epistemic products, namely "true beliefs, justified beliefs, understanding, wisdom, explanation, models, evidence, significant (rather than trivial) true beliefs, and the avoidance of false beliefs, among others" (p. 429). However, this argument may be contextually dependent, as it is unclear whether there is practical value in investigating which epistemic product about SRL is of greater epistemic value to teachers (e.g., whether knowledge about SRL is more valuable than understanding or true belief about SRL). The focus of this thesis, at a foundational level, is to consider whether knowledge about SRL is of value to educators, specifically middle-leaders. Fives et al. (2017), drawing on previous work (that is, Fives & Buehl, 2008), reported an alternative interpretation of Chinn et al.'s argument: that teachers place varying degrees of value on a range of teaching knowledge (e.g., student knowledge, knowledge about SRL). Following this line of argument, Chinn and Rinehart (2016) indicated that individuals and communities are likely to vary in the epistemic value they attach to certain domains of knowledge. For example, a teacher in a school that advocates traditional rote-learning practices is likely to have very little epistemic value for knowledge about SRL strategies. Similarly, a teacher in a school that promotes independent learning practices (e.g., inquiry learning, online learning) is likely to place greater epistemic value on knowledge about SRL, given its practical value in supporting students in autonomous learning environments.

Teachers' epistemic value for knowledge about SRL strategies can also be inferred from their set epistemic aims (i.e., knowledge aims). To acknowledge this relationship, Chinn et al. (2011), extending on Hofer and Pintrich's (1997) framework, positioned epistemic value and epistemic aims together in their Aims, Ideals and Reliable Processes (AIR) model. Chinn et al. argued that epistemic aims will only be set if the epistemic product is of value to the individual. For example, if teachers value knowledge of SRL strategies then they might aim to foster explicitly students' knowledge of SRL strategies. This is a potentially limited conceptualization when applied to the field of teaching, as the setting of epistemic aims are influenced by a broad range of school/classroom related factors (Galla, Amemiya, & Wang, 2018). For example, deciding explicitly to foster students' knowledge of SRL strategies may depend on real-time assessments of level of difficulty, time, other teaching goals and school structures. In the context of explicit teaching of SRL strategies, valuing students' knowledge about SRL strategies is simply not enough to drive teaching behaviour. It is the value of this epistemic product in comparison with those of other epistemic products and non-epistemic products. For example, teachers who value content

knowledge about their individual domains (e.g., English, Maths) more than the domain of SRL might oppose the explicit teaching of SRL strategies.

An alternative way of considering epistemic value about SRL is the value placed on tasks themselves: that is, the value of actions (i.e., enacted reliable processes) to achieve epistemic products. From this angle, epistemic value relates to teacher motivation for engaging in the task of explicitly teaching SRL strategies. Like the question Pintrich and De Groot (1990) posed in relation to student motivation, teachers are answering the same question: "Why am I doing this task?" Task value can stem from epistemic value attached to an epistemic product (i.e., knowledge about SRL strategies), but it can also stem from attainment value, intrinsic value, utility value and cost (Eccles & Wigfield, 2002). For example, a teacher may explicitly teach SRL strategies because demonstrating their professional competence to do so is important to them (i.e., attainment value), they find enjoyment in the task (i.e., intrinsic value, related to intrinsic motivation) (Deci & Ryan, 1985), it is useful as it helps them teach to the students' point of need (i.e., utility value), or that the "costs" associated with the task (i.e., cost value) are less than the perceived value/benefits. A teacher may also set epistemic aims about SRL, select reliable processes and subsequently enact both because they are motivated by one or all of these dimensions.

Teacher epistemic cognition about SRL is clearly value-laden. Researchers have argued that teachers who value knowledge of SRL strategies have a greater likelihood of explicitly fostering student knowledge of SRL strategies (De Smul et al., 2018; Dignath-van Ewijk & van der Werf, 2012). Teachers' epistemic value for knowledge of SRL strategies or the task of explicitly teaching SRL strategies may explain why teachers have not been able to achieve expertise/mastery in the domain of SRL. For example, Dignath and Büttner (2018), drawing on lesson-observations and interviews with secondary school teachers, reported that teachers value teaching of "cognitive and motivation strategies [as] more important than metacognitive strategies" (p. 145). Dignath and Büttner argued that epistemic value placed on strategy knowledge may only translate into practice when the epistemic value is high, as was the case for one of the secondary school teachers in their study.

2.4. Epistemic Cognition as a Metacognitive Process

There is consensus that epistemic cognition involves metacognition (for example, Barzilai & Zohar, 2016; Hofer, 2018; Kitchener, 1983; D. Kuhn, 2001; Lunn Brownlee et al., 2019; Lunn Brownlee, Schraw, Walker, & Ryan, 2016). While the term metacognition continues to lack a shared definition (Dinsmore, Alexander, & Loughlin, 2008), popular conception is that it covers two aspects: knowledge of cognition and regulation of cognition (Brown, 1987). Knowledge of cognition comprises an understanding of memory processes (Flavell, 1979), while regulation of cognition

encompasses monitoring and adaptation of memory processes (Brown, 1987; Jacobs & Paris, 1987). Barzilai and Zohar (2014) applied this understanding of metacognition to the field of epistemic cognition, suggesting the term *epistemic metacognitive knowledge*. Hofer (2018) located "epistemological awareness within metacognition" (p. 229), postulating an advancement from metacognition as "thinking about thinking" to also encompass "thinking about knowing'" (p. 229).

I understand epistemic metacognition to be *thinking about thinking that is specific to knowing and knowledge*. Therefore, building on Brown's (1987) work and similar to Barzilai and Chinn (2018), I conceived epistemic metacognitive knowledge of comprising two components: knowledge of epistemic cognition and regulation of epistemic cognition.

Knowledge of epistemic cognition involves knowledge of different epistemic aims and value, reliable processes and epistemic ideals (Barzilai & Chinn, 2018). A teacher engaged in high quality epistemic cognition would know what epistemic aims are available. Additionally, this teacher would be able to draw on high quality declarative, procedural and conditional knowledge of reliable processes; be aware of the pros and cons of each (justifying one as better than the others); and be able to carefully select the most appropriate process to achieve their set epistemic aims. Lastly, this teacher would be aware of their own epistemic ideals (and perhaps those of the educational and scientific community) and would use these to evaluate their epistemic products (Barzilai & Chinn, 2018).

Regulation of epistemic cognition involves knowledge of the process of epistemic cognition, namely *epistemic forethought*, *epistemic performance* and *epistemic self-reflection* (refer Section 2.2.1), and the strategies to regulate this process. For example, a teacher engaged in high quality epistemic cognition would engage in epistemic forethought, generating a list of different epistemic aims. Furthermore, this teacher would engage in productive self-talk, deliberating over school context with themselves, deciding on a course of action and then performing it. During epistemic *performance*, this teacher would engage in epistemic monitoring and control, deciding whether implemented processes are moving them closer to achieving their epistemic aims or whether changes in approach are required. Epistemic control may also involve suspending judgement about a knowledge claim (Barzilai & Chinn, 2018; Sosa, 2015). Finally, this teacher would engage in a process of epistemic *self-reflection*, evaluating the epistemic products and processes for their students and themselves.

The following sub-sections provide a detailed description of each of the three phases:

- Epistemic forethought.
- Epistemic performance.

- Epistemic self-reflection.

In Section 2.4, I discuss the critical role of epistemic reflexivity, predominantly occurring in the epistemic forethought phase and influencing epistemic performance.

2.4.1. Epistemic forethought: epistemic aims and reliable processes

The epistemic forethought phase of epistemic cognition consists of setting epistemic aims and selecting reliable processes (Chinn et al., 2011; Chinn et al., 2014; Lunn Brownlee et al., 2017). The following sub-sections detail setting of epistemic aims about SRL and selection of reliable process to achieve the set epistemic aims.

Setting epistemic aims about SRL

Epistemic aims are knowledge-focused goals, goals "related to a learning inquiry, such as attaining knowledge, understanding and true beliefs" (Chinn et al., 2011, p. 142). Fives et al. (2017) suggested that, in the context of teaching and learning, these goals can be drawn from several different knowledge areas (e.g., assessment instruction, classroom climate). For instance, to set the epistemic aim of fostering students' knowledge of motivational strategies, a teacher would need to draw on their prior knowledge of motivational strategies, students' current knowledge of motivational strategies and beliefs about how students construct knowledge of motivational strategies.

Chinn and colleagues (Chinn et al., 2011; Chinn et al., 2014) argued that an individual's epistemic aims are formed in relation to what they value and subsequently combined epistemic aims with epistemic value in their AIR model. For example, a teacher may seek to know how their students are engaged in SRL. This epistemic aim is likely to have practical value for the teacher, as the information gained can be used to guide future practice and to justify the choice to explicitly teach students SRL strategies.

Teachers may also possess multiple aims at any one time (for example, Archer, 2003; Buehl & Fives, 2016). For example, teachers in Australia are guided by the Australian Curriculum that includes aims related to content, general capabilities and cross-curriculum priorities. Additionally, teachers set aims to meet the Australian Professional Standards for Teachers (AITSL, 2020). Fives et al. (2017) postulated that while teachers may possess epistemic aims for their students, they also possess them for themselves. For example, a teacher may set an epistemic aim for students to develop their knowledge about SRL strategies. At the same time, the teacher may wish to determine what students already know about SRL, inevitably setting the epistemic aim of developing their own knowledge of students' knowledge about SRL. Archer (2003) advocated that researchers should evaluate each aim in the context of all aims. This is a problem for the

researcher who is fine-grained in their focus (i.e., explicit teaching of SRL strategies) and limited in resources (Ph.D.) compared to the teacher who continues to possess multiple aims.

Selecting reliable processes (to achieve epistemic aims about SRL)

Drawing upon the theory of process reliabilism (Goldman, 1986), Chinn et al. (2011), in their AIR model, posited that processes (e.g., cognitive, inquiry, social) used to achieve epistemic aims are either reliable or unreliable. A process is considered reliable if it leads to knowledge, understanding or a justified true belief, and unreliable if it doesn't (Chinn & Rinehart, 2016). According to Chinn and Rinehart (2016), reliable processes can be applied "to create epistemic products… [or] to evaluate others' epistemic products and justify these evaluations" (p. 471). Researchers in the field of epistemic cognition commonly report reliable processes as perception, reasoned argumentation and testimony (Chinn & Rinehart, 2016; Iordanou, Kendeou, & Beker, 2016). Indeed, reliable processes have been argued to vary by domain and context (Buehl & Fives, 2016; Chinn & Rinehart, 2016).

According to Fives et al. (2017), "teachers may choose to employ teaching-related strategies as reliable processes" (p. 274). For example, a teacher might regard the use of a learning protocol (a worksheet with metacognitive prompts; Eilam & Reiter, 2014) as a worthwhile process to collect information about their students' SRL and subsequently to develop knowledge about how their students engage in SRL. A teacher with an epistemic aim of developing students' knowledge about SRL strategies may choose reliable processes to instruct SRL strategies explicitly (Kiewra, 2002; Kistner et al., 2015) or may choose a learning protocol that prompts SRL strategy use (Eilam & Reiter, 2014). Another example of a reliable process for assessing student knowledge about SRL is interviews. For example, Askell-Williams and Lawson (2005) reported that the "simple act of conducting an interview about learning… can provide insight, for both teacher and student, into [the students'] knowledge about learning" (p. 33). With this new knowledge attained from the interview, teachers can prepare appropriate SRL interventions.

2.4.2. Epistemic performance: reliable processes

Epistemic performance is the enactment of a teacher's chosen reliable processes: the teaching actions implemented to achieve epistemic aims (Buehl & Fives, 2016). For example, a teacher with the epistemic aim of understanding how their students are engaging in SRL may implement a questionnaire to collect information about their students' SRL knowledge.

There are notable differences in the positioning of *epistemic performance* in my model epistemic cognition for teaching about SRL (refer section 2.2.1) and other models of teachers' epistemic cognition (for example, Buehl & Fives, 2016; Fives et al., 2017). For instance, Buehl and Fives (2016), in their framework for epistemic cognition in learning and teaching, theorised

epistemic performance (termed “epistemically informed praxis”) as an epistemic product. Building on this framework, Fives et al. (2017) positioned epistemically informed praxis as an epistemic product as part of their model of epistemic cognition in teaching. However, they stressed that their model should not be viewed as linear but rather “recursive, iterative, and multidirectional” (p. 272), implying that epistemic performance would feed back into the selection of epistemic aims and other phases. Common epistemic products include knowledge, understanding and justified true belief, so I have not positioned epistemic performance under the umbrella of an epistemic product, but rather as a phase in the process of epistemic cognition. Additionally, acknowledging the “recursive, iterative, and multi-directional” nature of epistemic cognition, there is further justification to locate epistemic performance as a phase in a broader process model of epistemic cognition, rather than as a product of the process. Epistemic performance is not solely a behaviour (i.e., product), it is the epistemically cognitive processes that are involved in implementing the behaviour and monitoring the behaviour. In the epistemic performance phase, a teacher engaged in high quality epistemic cognition about SRL would draw on their knowledge and beliefs about SRL and decisions made in the forethought phase to carefully implement reliable processes about SRL. This would involve meticulous attention to the process of explicit teaching of SRL strategies (e.g., naming, explaining, modelling and providing opportunities for student practice).

2.4.3. Self-Reflection: epistemic ideals and epistemic stances

The self-reflection phase involves (1) epistemic products, (2) application of epistemic ideals to evaluate those epistemic products and (3) adoption of an epistemic stance. *Epistemic products* (also known as epistemic ends, epistemic achievements, epistemic accomplishments) are the outcomes in the process of epistemic cognition. They are the objective epistemic mental representations (e.g., knowledge, understanding, true belief) that result from enacted reliable processes. In the context of teaching for SRL, epistemic products refer to the quality of students’ knowledge about SRL, or the quality of teacher’s knowledge about their students’ SRL knowledge.

Epistemic products about SRL undergo a process of evaluation, in which a teacher applies epistemic ideals (refer section 2.3.3) and adopts an epistemic stance. There is consensus that *epistemic stances* are the position, attitude or perspective that a teacher possesses about knowledge – believing or not believing a claim, holding a claim as certain or uncertain, or tentatively or partially agreeing with a claim (Buehl & Fives, 2016; Chinn et al., 2011; Goldman, 1986; Greene et al., 2016). Like Chinn et al. (2011), I have situated the epistemic belief about *certainty* of SRL knowledge (Section 2.3.2) as an epistemic stance. A teacher certain in knowledge, therefore believes it is well-justified and that it has satisfied the necessary epistemic ideals. In the self-reflection phase, a teacher engaged in high quality epistemic cognition would

assess the epistemic products about SRL for their students (and themself) against evidence-based epistemic ideals, forming a well-justified belief with certainty.

2.5. Role of Epistemic Reflexivity for Teachers and SRL

Prior to exploring the role of epistemic reflexivity in teaching about SRL, it is important to first document my understanding of reflexivity and distinguish it from the common term 'reflection'.

2.5.1. Defining reflection and reflexivity

Distinguishing reflection from reflexivity was admittedly challenging. Archer, a prominent researcher in the field of reflexivity, acknowledged that the boundaries between reflection and reflexivity are "fuzzy" (Archer, 2010b, p. 2); however, I have attempted to distinguish these terms here.

Reflection can be thought of as "the action of a subject towards an object", commonly noted as subject-object (Archer, 2010b, p. 2). It can be thinking about, pondering, musing or mulling over a past, present or future event. For example, reflection might occur after an event (i.e., reflection-on-action), whereby the person reflecting might ask themselves 'what happened?', 'how do I think or feel about what happened?' and 'what might others be thinking or feeling about the event?' (Bolton & Delderfield, 2018; Schön, 1987). Furthermore, someone might reflect on their goals and consider what they should do next (reflection-for-action), or they may reflect in the moment and consider where their attention is being allocated and consider changing it (reflection-in-action). Archer (2010b) argued that "reflection can be directed at any object whatsoever" and provided examples of reflection as follows: "Is it safe to cross the road? Do they take credit cards here?" or "thinking out an argument or doing a crossword puzzle" (p. 2).

In comparison to reflection, reflexivity is defined as "the regular exercise of the mental ability, shared by all normal people, to consider themselves in relation to their (social) contexts and vice-versa" (Archer, 2010b, p. i). It can be understood as self-talk that "involves mental and self-referential 'bending back' upon oneself" (Archer, 2010b, p. 3). Building on Mead's (1934) and Peirce's (1984) work, Wiley (2010) proposed that reflexivity, as self-talk, occurs between three components of the self: "I" (the present-self), "you" (future-self) and "me" (past-self, i.e., memory of self and others). Numerous researchers have referred to reflexivity as subject-object-subject (different from reflection which is only subject-object), where "I" and "you" are subjects and "me" is an object (Archer, 2010b; Fives et al., 2017; Lunn Brownlee et al., 2017; Lunn Brownlee et al., 2016). According to Bolton and Delderfield (2018), reflexivity is "focusing close attention upon one's own actions, thoughts, feelings, values, identity, and their effect upon others, situations, and professional and social structures" (p. 14). It moves beyond the self-talk/self-questioning structures

of reflection (e.g., what happened?), to a deeper level of self-talk/self-questioning about one's own thinking, values, emotions, biases in relation to others (e.g., what will others think of me? Do I care? Can I cope with this?) (Bolton & Delderfield, 2018). Archer (2010b) indicated that reflexivity involved matters of being concerned with oneself and social structures. A reflexive individual will utilise self-questioning strategies to interrogate their thought processes, their knowledge and belief systems, including biases, habitual thinking or assumptions, in a social context (Bolton & Delderfield, 2018).

The role of reflexivity in voluntary behaviours can be traced back to the late 1800s. For example, W. James (2001), in a lecture on psychology, stated that the self-question "'Will you or won't you have it so?' is the most probing question we are ever asked" (p. 327). Contemporary understanding of *reflexivity* originates from different self-theories: W. James' (2007) work on introspection and five principles of thought, Bakhtin's (1973) dialogical processes, Vygotsky's (1962) early work about inner speech, Peirce's (1984) theory of the internal conversation and Mead's (1934) focus on inner dialogue between the self and society. Most recently, Archer's (2000, 2003, 2007, 2010a, 2010b) extensive program of research, along with Wiley (2010), and followed by Lunn Brownlee et al. (2017) in collaboration with the Cyprus Advanced Study Colloquium (2015, August) have substantially progressed thinking about reflexivity (and epistemic reflexivity) as three moments within the conversation. Table 2.2 documents alignment between different views on the three moments of reflexivity.

Table 2.2. Comparison of research on reflexivity (from Barr & Askell-Williams, 2020b, p. 356)

Researcher(s)	Moments in the reflexive conversation			
Archer (2000)	Discernment	Deliberation	Dedication	
Wiley (2010)	Defining (*similar to a combination of Archer's Discernment and Deliberation*)	Choosing		Enacting
Lunn Brownlee et al. (2017); Lunn Brownlee et al. (2019)	Reflect-discern (*similar to a combination of Archer's Discernment, Deliberation and Dedication moments)*		Reflexivity-deliberate	Resolved action-dedicate

2.5.2. Frameworks of epistemic reflexivity

Drawing on my understanding of reflexivity, *epistemic reflexivity* can be thought of as a mental and self-referential bending back upon oneself in the context of knowledge and knowing in relation to the environment (e.g., structural and cultural conditions).

From Table 2.2. it can be seen that Archer (2000) suggested three moments of reflexivity known as Discernment, Deliberation and Dedication (DDD scheme). *Discernment* is when an individual initially considers their aims by listing all potential aims of value. Berkman, Hutcherson, Livingston, Kahn, and Inzlicht (2017) described this as value-based decision-making, "selecting from a set of options based on their relative subjective value" (p. 423). Berkman et al. argued that this process was guided by attention to aims of value and therefore listed. *Deliberation* is a "provisional ranking" of the aims, essentially responding to the self-question "How much do you care about…?" (Archer, 2003, p. 236) and involves a weighing up costs and benefits of each aim against each other listed aim. The deliberation phase can also include the generation of hypothetical scenarios to further inform prioritization. *Dedication* is where an individual makes a commitment to progress chosen aims into action. Archer (2003) noted that even at the time of dedication, individuals hold multiple concerns and these concerns are constantly undergoing reflexive revision.

Wiley (2010) also proposed three moments of reflexivity: *Defining, Choosing* and *Enacting*. *Defining* shares similarities to Archer's *discernment* and *deliberation* moments as it involves a listing of possible aims and an evaluation of importance. *Choosing* is when the individual chooses an aim to progress, like Archer's *dedication* moment. *Enacting* is the actual implementation of the aim. Wiley (2010) raised the issue of a time gap between *choosing* and *enacting* which creates opportunity for further reflexivity, potentially altering the course of action. This issue aligns with Archer's view that *dedication* can undergo cycles of revision.

In a prominent attempt to interpret Archer's DDD scheme and situate it within teaching and learning and teachers' epistemic cognition, Lunn Brownlee et al. (2017) and later Lunn Brownlee et al. (2019) theorised a three-step framework (3R-EC framework of reflexivity): *Reflect-discern*, *Reflexivity-deliberate* and *Resolved action-dedicate*. In this framework of reflexivity, *Reflect-discern* involves identifying epistemic aims. It appears different from Archer's *discernment* and Wiley's *defining* moments that placed emphasis on the generation of aims but not necessarily a commitment to any aim. *Reflexivity-deliberate* refers to an evaluation of "multiple, potentially competing perspectives on an issue through internal dialogue" (Lunn Brownlee et al., 2019, p. 235). Stating that this second moment involved "internal dialogue" may suggest that reflexive internal dialogue does not occur in the first or third moments. Again, this was different from

Archer's DDD scheme that advocated for three moments of a broader internal conversation. Lunn Brownlee et al.'s (2019) final moment *Resolved action-dedicate* emphasises a "need for decision making to lead to action" (p. 235) and is similar to Wiley's (2010) third moment (i.e., enacting).

Table 2.2 highlights substantial variation in the different views on the three moments of reflexivity and suggests that three moments may not be sufficient to encapsulate all moments of reflexivity. Building on these prior models, I offer a new process framework called the DDD-D process for epistemic reflexivity that provides a more holistic view of the moments of epistemic reflexivity (refer Figure 2.2).

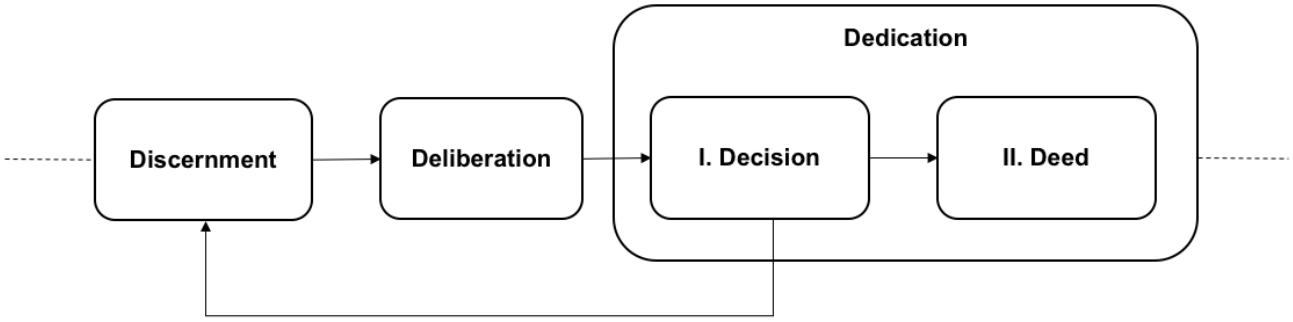

Figure 2.2. DDD-D process framework of epistemic reflexivity

In order not to lose detail provided by Archer in the *discernment* and *deliberation* moments, not clearly apparent in other interpretations (for example, Lunn Brownlee et al., 2017; Lunn Brownlee et al., 2019), I have included both *Discernment* and *Deliberation* as individual moments of the reflexive conversation. To acknowledge the difference between choosing an action (Wiley's *choosing* moment; Archer's *dedication* moment), and the enactment of that action, I have included two parts to the *Dedication* moment, the first being *Decision* (i.e., choice) and the second being *Deed* (i.e., enactment). By separating choice from action, it is possible to clearly acknowledge the potential for ongoing revision of the decision. Finally, the dotted lines on the far left and right of the diagram indicates that this DDD-D process is only four moments in a broader internal conversation.

2.5.3. Epistemic reflexivity and epistemic cognition

Epistemic reflexivity is a critical sub-process in teachers' epistemic cognition (Lunn Brownlee et al., 2017; Lunn Brownlee et al., 2019; Weinstock et al., 2017). The process of epistemic reflexivity arguably occurs during the epistemic forethought phase (i.e., *discernment*, *deliberation* and *decision* moments) with a direct connection to epistemic performance (i.e., *deed* moment), such as the explicit teaching of SRL strategies. It is important to reiterate here that the school context and other environmental factors (e.g., school culture, government expectations, policy) influence the process of epistemic cognition, including the sub-process of epistemic reflexivity. Indeed, the

interaction between environment and the agent themselves is core to theoretical understandings of epistemic reflexivity or more broadly reflexivity. For example, Lunn Brownlee et al. (2019), in their conceptualisation of epistemic cognition, stated that the process included "reflexively weighing up personal and contextual concerns" (p. 232). Therefore, the quality of teachers' explicit teaching of SRL strategies is dependent on the quality of teachers' knowledge and beliefs about SRL, their epistemic reflexivity about SRL and, more broadly, their epistemic cognition about SRL in relation to their environment.

Teachers' high quality epistemic cognition about SRL requires teachers to engage in high quality epistemic reflexivity about SRL (Barzilai & Chinn, 2018). For example, a teacher demonstrating high quality epistemic cognition about SRL would, via their epistemic reflexivity in the forethought phase, draw on an extensive and well-founded knowledge and beliefs about SRL and choose suitable epistemic aims and reliable processes about SRL, and consider carefully the interplay of such choices with their own personal values and motives and those of the broader school context (e.g., structural and cultural conditions). They might pose a self-question (e.g., What do my students know about SRL strategies? What is the quality of their knowledge? Do they possess deep knowledge of a diverse set of motivational, cognitive and metacognitive strategies?) or engage in self-talk prior to clearly defining their epistemic aim for their students (e.g., students demonstrate knowledge of SRL strategies).

2.5.4. Reflexive disposition and epistemic reflexivity

Some researchers have conceived of a "reflexive disposition" (i.e., engagement in epistemic reflexivity) as an epistemic virtue (for example, Fives et al., 2017). Epistemic virtues and vices are learned dispositions that either enable or hinder achievement of epistemic aims (Chinn et al., 2011; Weinstock et al., 2017), and stem from virtue epistemology and virtue ethics (Baehr, 2016). A critical feature of these epistemic "dispositions" is their direction toward an epistemic aim (e.g., toward true beliefs, knowledge, understanding). Mason (2016) explained that epistemic virtues lead to an individual engaging in reliable processes, while epistemic vices result in selecting unreliable processes towards the set epistemic aims. Researchers in the field of epistemic cognition have documented an extensive range of epistemic virtues: intellectual courage, impartiality and intellectual sobriety (Montmarquet, 1987), flexibility, vigour, thoroughness, humility, fair-mindedness, insightfulness, perseverance and open-mindedness (Zagzebski, 1996), along with accuracy and sincerity (Williams, 2002) and attentiveness and intellectual diligence (Baehr, 2011). A similar list has been documented for epistemic vices: intellectual cowardice, dishonesty and closed mindedness (Chinn et al., 2011; Chinn et al., 2014; Mason, 2016). However, researchers differ in whether a reflexive disposition is an epistemic virtue. For example, Barzilai

and Chinn (2018) argued that epistemic virtues are not “motivational dispositions or character traits” (e.g., reflexive disposition) but are “multifaceted, developing, and adaptive intellectual competencies” (p. 360). Whereas, Weinstock et al. (2017) argued that a reflexive disposition “is an epistemic virtue in how it orients one toward inquiry and achieving epistemic aims through central characteristics of considering one’s thinking as it relates to the object of thought, and to ‘bend back’ or re-evaluate decisions” (p. 287). Barzilai and Chinn’s conceptualization originates from the reliabilist approach (placing emphasis on cognitive abilities), whereas other researchers (for example, Fives et al., 2017) appear to have adopted a responsibilist approach (placing emphasis on intellectual motivational dispositions). I see little value in whether or not a reflexive disposition is an epistemic virtue or not, rather that there is consensus that the probability of teachers engaging in high quality epistemic cognition depends on engaging in reflexivity (Giovannelli, 2003; Hofer, 2017).

2.6. Enhancing Quality of Epistemic Cognition for Teaching about SRL

Schraw, Olafson, and Lunn Brownlee (2017) reviewed research on teachers’ personal epistemologies and reported five themes emerging in the literature, the most important being the need to support the development of teachers’ epistemic cognition. However, this development is not easy given researchers have stated that beliefs, in this case teachers’ epistemic beliefs, are formed over a long period of time and can be highly resistant to change (Woolfolk Hoy, Davis, & Pape, 2006). According to Fives et al. (2017), researchers can focus on achieving change in one of the influencing aspects of epistemic cognition for teaching in the hope that this might instigate change in the whole system. However Fives et al. (2017) advocate that “multiple components [of epistemic cognition for teaching] need to be addressed and a disposition toward reflexivity needs to be fostered and supported” (p. 281).

In my search of the literature, two primary ways for achieving change in epistemic cognition for teaching were found: stimulating conceptual change in teachers’ knowledge and beliefs and prompting teachers’ engagement in epistemic reflexivity. These two ways are described in the following sub-sections. A third sub-section contains a description of a hybrid professional education program that emerges from the two ways.

2.6.1. Stimulating conceptual change in teacher knowledge and beliefs about SRL

There is consensus that stimulating conceptual change in teachers’ knowledge and beliefs could be a worthwhile method for achieving change in epistemic cognition for teaching (for example, Lunn Brownlee et al., 2016). The term *conceptual change* was first introduced by T. S. Kuhn

(1962) to describe substantial changes in a scientific theory (i.e., paradigmatic shifts, scientific revolutions) that occurred when new evidence and ideas were mutually agreed upon by the scientific community. Since its introduction, the term has also been used to describe how concepts change during learning. For example, conceptual change can occur as a *weak restructuring* – an assimilation (Piaget, 1970b) or elaboration of a concept (Inagaki & Hatano, 2013) – or as a *radical restructuring*, in which concepts are substantially reorganised (Vosniadou & Brewer, 1987) and accommodated (Piaget, 1970b). Some researchers have argued that conceptual change requires *possessing* new knowledge (i.e., understanding, construction of new knowledge) and also *believing* it (Chinn & Samarapungavan, 2001, 2009). According to Chinn et al. (2013) "sometimes belief and understanding may move in lockstep; sometimes they diverge" (p. 545). To claim that conceptual change has occurred, researchers have argued that an alteration (weak or radical, knowledge and/or belief) must have occurred in the content or in the structure and organization of prior knowledge or beliefs (Inagaki & Hatano, 2013; Vosniadou, 2013b).

Since the early 1980s, different approaches have emerged to document the conditions within which conceptual change occurs. For example, Posner, Strike, Hewson, and Gertzog (1982) proposed that conceptual change occurred under four conditions: "(1) there must be dissatisfaction with existing conceptions… (2) a new conception must be intelligible… (3) a new conception must appear initially plausible… [and] (4) a new concept should suggest the possibility of a fruitful program" (p. 214). This approach, known as the classical approach to conceptual change, advocated a key role of cognitive conflict, which leads to relatively immediate insights in the process of conceptual change. Since inception, the classical approach has undergone substantial criticism. Recent conceptual change theorists have advocated a broader, multiple perspective approach acknowledging that situational, affective, motivational and cognitive aspects influence conceptual change (Pintrich, Marx, & Boyle, 1993; Sinatra & Mason, 2013) and that conceptual change is not an immediate shift, but a gradual process involving continuous enrichment and restructuring (Vosniadou, 2013b; Vosniadou & Skopeliti, 2014).

Numerous frameworks and perspectives surfaced to address these criticisms (for example, Knowledge integration, D. B. Clark & Linn, 2013; Knowledge in pieces, diSessa, 2013; diSessa, 2018). One prominent approach in the context of Science and Mathematics is the framework theory (Vosniadou, 2013a), an approach that advocates for enrichment mechanisms (e.g., using analogies, contrasting models) that promote "gradual knowledge revision" (Vosniadou, 2013a, p. 25), while other approaches have asserted that the learner must play a "consciously" active role in the process of conceptual change (for example, Bereiter & Scardamalia, 2013; Sinatra & Mason, 2013). The latter perspective positions teachers as agents: self-aware, personal constructors of their own knowledge. To engage in intentional conceptual change requires a learner to act as a

reflective practitioner (Schön, 1987) in thinking about the concepts being learned, and to possess the necessary metacognitive abilities “to assess and monitor incongruity within the existing knowledge system” (Inagaki & Hatano, 2013, p. 214).

Historically, conceptual change research has subscribed to a single approach (that is, classical approach to conceptual change). There is increasing acknowledgement amid researchers that using a combination of approaches and addressing multiple perspectives (situational, affective and motivational) will yield better outcomes (Duit, Treagust, & Widodo, 2013; Vosniadou, Ioannades, Dimitrakopoulou, & Papademetriou, 2001; Vosniadou et al., 2020), although such approaches are still rare (Sinatra & Mason, 2013). As a result, researchers have advocated for the design and evaluation of professional education that combines conceptual change approaches and therefore supports teachers’ conceptual change in relation to SRL (Dignath & Büttner, 2018; Vosniadou et al., 2020) and, more broadly, sustainability of school improvement initiatives about SRL. Additionally, Vosniadou et al. (2020) stated that “taking a conceptual change perspective can provide new methodological insights about how to study teachers’ belief systems and about how to find effective ways to induce belief change” (p.15). Lunn Brownlee et al. (2016), in their review of conceptual change studies with pre-service teachers, reported that past interventions have achieved conceptual change in aspects of teachers’ epistemic cognition through constructivist approaches, such as inquiry-based learning methods or professional learning communities. This is consistent with Barr and Askell-William’s (2020a) research that reported the positive effect of a researcher-facilitated PLC about SRL.

Professional learning communities

Professional Learning Communities (PLCs) (Bowe & Gore, 2016; DuFour & Eaker, 1998; Louis & Marks, 1996; Vangrieken, Meredith, Packer, & Kyndt, 2017; Vescio et al., 2008) are well supported to promote conceptual change (Chinn, Duncan, Dianovsky, & Rinehart, 2013) and achieve positive teaching and learning outcomes (Vescio et al., 2008). In PLCs, participants are involved in an inquiry process (investigating a problem of practice) that includes collaborative discussions: sharing ideas, reflecting on practice, observing each other’s classes, co-constructing resources and critically engaging with authentic samples of students’ learning (DuFour & Eaker, 1998; Lee Bae, Hayes, Seitz, O'Connor, & DiStefano, 2016).

PLCs offer a vehicle for combining different conceptual change approaches. It is possible to utilise cognitive conflict (classical change approach), carefully planned enrichment mechanisms (framework theory approach), or to encourage the learner to take an active role in learning (i.e., intentional conceptual change). Inquiry-based conceptual change methods like PLCs are thought to foster both knowledge and belief, addressing a concern raised by Chinn et al. (2013).

PLCs are a highly topical form of continuous professional development in Australia (for example, New South Wales State Government, 2019; Victoria State Government, 2020). According to the TALIS 2018 report (OECD, 2019), continuous professional development takes many forms with "the most common [being] 'courses and/or seminars attended in person' (76%) and 'reading professional literature' (72%), followed by 'education conferences' (49%), and training based on peer learning and coaching (44%)" (p. 2). PLCs do not neatly fall under one of reported categories (e.g., courses, seminars, reading professional literature), rather bringing together aspects of the different categories. According to Bowe and Gore (2016), "PLCs typically approach knowledge as much more fluid and uncertain than conventional forms of professional development, valuing teachers' capacities to name and solve problems in collaboration with colleagues who understand the [local] context" (p. 3). As PLCs are highly contextual, they offer a high-potential pathway to improve teachers' epistemic cognition about SRL (also highly context-specific), and to support the sustainability of school improvement initiatives about SRL.

In a review study about PLCs, Vescio et al. (2008) also conveyed numerous positive outcomes associated with PLCs (e.g., enhanced knowledge); however, they reported that seven of the eleven PLC studies analysed "did not provide significant detail on the changes made to teachers' practices, instead change was alluded to without explicit documentation or detail" (p. 84). Indeed, Vescio et al. (2008) argued that the lack of details about PLC studies "was pervasive in the research studies" (p. 84). In a more recent review study, Dogan et al. (2016) considered 14 articles that investigated the impact of PLCs on aspects of science teachers' knowledge and beliefs and practice. They reported that PLCs had a positive effect on aspects of the teachers' knowledge and beliefs (i.e., growth in teacher's knowledge). However, they highlighted a similar argument to Vescio et al. (2008), that PLC studies rarely provided sufficient detail of how the PLC was conducted and of the teachers' involvement. Without clarity of the PLC or how teachers engaged in the PLC, claims of causation or effects of PLCs are questionable.

Furthermore, previous evaluation studies have typically only reported proximal effects (for example, Vescio et al., 2008) overlooking the need to consider distal effects of PLCs. For example, Gaikhorst et al. (2017) stated that "little is known about the characteristics of and activities in PLCs that contribute to the sustainability of professional development interventions" (p. 135). In a quasi-experimental study, Gaikhorst et al. (2017) explored the distal effects of a PLC conducted with 72 graduate teachers working in urban schools. They assessed whether immediate positive changes were consistent with data collected a year later and reported that "a significant long-term effect of the programme was found on teachers' competences [i.e., knowledge] and professional orientation [restricted orientation vs. extended professional orientation]" (p. 135). Additionally, they listed that an open learning culture, where teachers and leaders felt safe to share with their peers, was a

critical determinant for sustained effects. An open learning culture is arguably inherent to a high-quality PLC, supporting the potential for a PLC about SRL to contribute to sustained uptake of SRL teaching initiatives. Gaikhorst et al. (2017) acknowledged that their study was limited in that they "paid no explicit attention to individual teacher attributes that might have an impact on the transfer process and sustainability" of the PLC (p. 152) and did not consider the effects of the PLC on students.

2.6.2. Prompting teacher engagement in epistemic reflexivity about SRL

In addition to creating a conceptual change supporting learning environment such as a PLC, researchers have advocated that explicit engagement in epistemic reflexivity can support quality improvement in teachers' epistemic cognition (Lunn Brownlee et al., 2016). Furthermore, in a time of "new professionalism", researchers have advocated that teachers must develop their ability to engage in the process of epistemic reflexivity (Meijers & Hermans, 2018; Ryan & Bourke, 2013), and that reflection and reflexivity "embodies the essence of being a professional" (Feucht et al., 2017, p. 234).

Previous studies have promoted explicit reflection on beliefs (particularly epistemic beliefs) as a method to achieve change in epistemic cognition (for example, Feucht et al., 2017; Lunn Brownlee, Schraw, & Berthelsen, 2011). For instance, Lawson et al. (2018), in their proposed set of beliefs that influence learning, claimed that teachers' beliefs "need to be made explicit and examined" in order to enhance teaching practice (p. 223). Lunn-Brownlee and colleagues (Lunn Brownlee et al., 2017; Lunn Brownlee et al., 2016) have progressed this notion of explicit reflection on beliefs to explicit engagement in a process of epistemic reflexivity (i.e., the 3R-EC framework of epistemic reflexivity). Indeed, Weinstock et al. (2017) recommended that individuals (i.e., teachers) should engage in the phases of the 3R-EC framework (Lunn Brownlee et al., 2017) to improve their epistemic reflexivity. I extend this recommendation to engagement in the DDD-D process of epistemic reflexivity (discussed earlier in section 2.5).

As epistemic reflexivity is a process, it is theoretically possible to explicitly prompt teachers' engagement in this process, in a similar way to prompting student reflection. Grossman (2008) described different strategies that "scaffold" student reflection, including transformative and intensive reflection – where students were prompted to reflect on previously documented reflections. In a similar way, certain prompts can act as scaffolding for teachers' epistemic reflexivity, by facilitating their engagement in the process of epistemic reflexivity. For example, if a teacher has planned a lesson, and is then asked to reflect on that lesson, this can instigate a process of transformation. By asking a teacher to consider their planned teaching actions from multiple perspectives (self, leadership, school) they are engaging in discerning, deliberating and

deciding. Teachers can either justify their decisions, or change their decisions because of the prompted reflection.

Very few studies have explored the effects of prompting of epistemic reflexivity about SRL on teachers' epistemic cognition. One exception is Barr and Askell-Williams' (2020a) study that considered the effects on epistemic cognition about SRL of a 12-week researcher-facilitated PLC about SRL with a group of four secondary school science teachers. Detailed analysis of interview transcripts and lesson plans indicated that teachers who engaged in the PLC about SRL, which incorporated reflexive "prompting" (embedded in PLC discussions), showed growth in their knowledge about SRL and changes in their beliefs about the source of SRL knowledge. Although Barr and Askell-Williams demonstrated useful results in the context of explicit teaching of SRL strategies, reflexive prompting was embedded in their PLC discussions, leaving scope for more targeted efforts at improving teachers' epistemic reflexivity and therefore their epistemic cognition.

Researchers have advocated that the quality of teachers' epistemic cognition and teaching practice, irrelevant of the subject, is dependent on the quality of their engagement in epistemic reflexivity (Fives et al., 2017). For instance, Ryan and Bourke (2013), drawing on the work of Archer (2010a), argued that in the absence of teacher reflexivity, "professional [teaching] actions may remain morphostatic [unchanging]" (p. 414), particularly in cases where change is required.

2.6.3. Professional epistemic education: PLC-ER

Combining the arguments for professional learning communities (PLC) and prompted engagement in epistemic reflexivity (ER), I have conceived of a hybrid professional education program termed PLC-ER. Barzilai and Chinn (2018) defined this type of professional education as *professional epistemic education* as it is characterized by acknowledgement of learners' epistemologies and the deliberate aim of achieving change in these epistemologies. With a predominant focus on school education, Barzilai and Chinn (2018) argued that "the primary objective of epistemic education should be to enable learners to reliably succeed, through competence, in epistemic activities such as forming accurate judgments or evaluating arguments, across a range of situations, and to appraise accurately through meta-competence when success can be achieved reliably enough" (p. 362).

The same principles can be applied to teacher education. Following engagement in a PLC-ER, teachers should be able to set appropriate epistemic aims and to enact reliable processes to achieve them (i.e., engage in high quality epistemic cognition). It means that teachers will be able to critically assess their own knowledge about students' developing knowledge drawing on high quality epistemic ideals and seek richer forms of evidence before making claims.

2.7. Evaluating Quality of Epistemic Cognition for Teaching about SRL

In my search of the literature I found little in relation to the direct evaluation of the quality of epistemic cognition for teaching. This is consistent with the argument that epistemic cognition for teaching is an emerging field. Some approaches were found that considered teachers' knowledge and/or beliefs (i.e., sub-component of epistemic cognition for teaching), what Battaly (2008) referred to as a traditional epistemological approach.

One relevant approach was that of Lawson, Askell-Williams, and Murray-Harvey (2003), who used a 4-point rating scale to evaluate the quality of *knowledge* about learning of final year Bachelor of Education students. The scale ranged from a simple propositional statement (1-point), an elaborative response (2-points), a statement about implication (3-points) or a connective statement between personal experience and theories of learning and instruction (4-points). The more points, the greater quality of knowledge. Building on this earlier work, Lawson and Askell-Williams (2012) proposed six quality dimensions: (a) *extent*, (b) *well-foundedness*, (c) *structure*, (d) *complexity*, (e) *generativity*, and (f) *variety of representational format*. In the context of teachers' prior knowledge about SRL: *extent* refers to the quantity of SRL knowledge (i.e., number of knowledge pieces) about SRL; w*ell-foundedness* is the accuracy between the teachers' knowledge about SRL and the research about SRL; *structure* refers to the connections (and coherence of connections) between SRL knowledge pieces (e.g., fragment vs. connected knowledge); *complexity* refers to the quality of the connections between pieces of SRL knowledge; *generativity* is the range of problem solutions brought to mind (when solving the problem of how to teach SRL); and *variety of representational format* refers to the different forms in which knowledge about SRL is stored.

Indeed, there is overlap between the six quality of knowledge dimensions of Lawson and Askell-Williams (2012), Chinn et al.'s (2014) proposed epistemic ideals and the common scientific explanatory ideal (refer Section 2.3.3), as shown in Table 2.3.

Table 2.3. Comparison of Lawson and Askell-Williams (2012), Chinn et al. (2014) and common explanatory ideals

Quality of knowledge dimensions (Lawson & Askell-Williams, 2012)	**Chinn et al.'s (2014) proposed categories of epistemic ideals**	**Correlating category of common *explanatory* ideal (Chinn et al., 2014, p. 433)**	**Proposed categories of epistemic ideals about explicit teaching of SRL strategies**
Extent	Nil	Nil	SRL knowledge is extensive

Quality of knowledge dimensions (Lawson & Askell-Williams, 2012)	Chinn et al.'s (2014) proposed categories of epistemic ideals	Correlating category of common *explanatory* ideal (Chinn et al., 2014, p. 433)	Proposed categories of epistemic ideals about explicit teaching of SRL strategies
Well-foundedness	Connections to other knowledge	5. coheres with other, scientific explanations	SRL knowledge coheres with other explanations
	Present and future connections to empirical evidence	1. explains a broad scope of evidence 2. is not contradicted by significant evidence 3. is fruitful for future research	SRL knowledge coheres with the available evidence-base
Structure (i.e., coherence)	Internal structure "the explanation specifies a causal mechanism; it is	4. is internally consistent 6. (in some fields) specifies a causal mechanism)	SRL knowledge is internally consistent
Complexity	internally consistent; it is sufficiently complex" (Chinn et al., 2014, p. 433)		SRL knowledge is sufficiently complex
Generativity	Nil	Nil	Broad range of problem solutions (to explicitly teaching SRL) are suggested
Variety of representational format	Nil	Nil	SRL knowledge is represented in different forms
Nil	Quality of communication	Nil	SRL knowledge is clearly communicated from student to teacher (i.e., coherence)
Nil	Quality of source	Nil	Source of SRL knowledge (e.g., age of student, general capability of student)

From Table 2.3, Chinn et al.'s (2014) proposed category of internal structure relates to Lawson and Askell-Williams' quality of knowledge dimensions of structure and complexity. Using this epistemic ideal, a researcher can consider the internal consistency of the teachers' knowledge and other aspects of the teachers' knowledge and beliefs (i.e., epistemic beliefs). Additionally, Chinn et al.'s categories of *connections to other knowledge*, and *present and future connections to*

empirical evidence is related to Lawson and Askell-Williams' (2012) quality dimension *well-foundedness*. For example, a researcher might ask - does the teachers' knowledge and beliefs about SRL cohere with the reviewed literature about SRL? Chinn et al.'s category *quality of source* does not have a corresponding quality of knowledge dimension, and in the context of research, is not particularly relevant, as all sources (i.e., participants) are arguably equally valid (i.e., each source contributes to the data set). Lastly, Chinn et al.'s *quality of source* corresponds to Lawson and Askell-Willliams' quality dimension of *structure*. The quality dimensions of *generativity* and *variety of representational format* assess different aspects of the quality of teachers' knowledge and beliefs. The final two criteria (i.e., quality of communication and quality of source) listed in Table 2.3 are less relevant to the present study, so Lawson and Askell-Williams' quality dimensions, already essentially incorporating Chinn et al.'s (2014) categories, were deemed a suitable set of criteria for assessing quality of epistemic cognition for teaching.

Other approaches found that evaluated epistemic cognition (more generally) adopted a focus on an individual's epistemic virtues in achieving their epistemic aims, what Battaly (2008) referred to as a virtue epistemological approach. For example, drawing on Sosa's (2007, 2011, 2013) work, Barzilai and Chinn (2018) proposed five criteria for the evaluation of high quality epistemic cognition (what they termed *apt epistemic performance*): "engaging in reliable cognitive processes that lead to the achievement of epistemic aims, adapting epistemic performance to diverse situations, metacognitively regulating and understanding epistemic performance, caring about and enjoying epistemic performance, and participating in epistemic performance together with others" (p. 353). This set of criteria highlights a conceptual difference between knowing and believing and deciding and enacting (i.e., the competent engagement in epistemic cognition; enacted knowledge).

There is benefit in drawing on both approaches (i.e., traditional epistemological approach and virtue epistemological approach). For example, the quality dimensions (Lawson & Askell-Williams, 2012) offer a useful set of criteria for assessing the quality of teachers' knowledge and beliefs about SRL, while Barzilai and Chinn's (2018) criteria target more of the process elements of epistemic cognition (e.g., setting of epistemic aims). Given the dual benefit, I argue it is theoretically possible to combine both approaches. For example, the quality dimensions (extent, well-foundedness, etc.) can be used to evaluate the quality of teachers' engagement *in reliable cognitive processes that lead to the achievement of epistemic aims* (Barzilai & Chinn's first criterion), as a method to assess the quality of teachers' engagement in setting epistemic aims and selecting reliable processes (i.e., their engagement in epistemic reflexivity). On this basis, the present study adopts a dual perspective (both traditional epistemology and virtue epistemology)

that enables evaluation of their epistemic cognition, namely teachers' knowledge and beliefs and their engagement in epistemic reflexivity.

Although the above review indicates that the literature on middle-leaders, SRL and Epistemic Cognition is extensive, with the exception of Helen Askell-William's and my earlier work (Barr & Askell-Williams, 2020a), I have found no research that specifically conceptualises or explores the quality of *middle-leaders' epistemic cognition for teaching about SRL*. In the above reviews I have extended the literature to develop a new model that incorporates quality teaching practice, Epistemic Cognition and SRL. In the next section I operationalise that model in order to address the research questions of this thesis.

2.8. Specific Aim, Research Questions, Hypotheses and Variables

Acknowledging the limited research in the field of school middle-leadership, I have drawn on the broader field of epistemic cognition (and teachers' epistemic cognition) to conceptualise school middle-leaders' epistemic cognition and practice related to the explicit teaching of SRL strategies.

This section contains the aim, research questions and hypotheses and variables for this study.

2.8.1. Aim

The present study aims to evaluate the changes that emerge in a school (i.e., changes in school middle-leaders' epistemic cognition, namely their knowledge and beliefs about SRL and epistemic reflexivity about SRL, and teaching practice about SRL, and by extension teachers' beliefs about SRL and students' SRL) when a PLC-ER about SRL was introduced with the school's middle-leaders.

2.8.2. Research Questions (RQ) and Hypotheses (H)

Research questions are listed for each participant group (i.e., school middle-leaders, teachers and students). Table 2.4 documents the research questions and hypotheses related to school middle-leaders.

Table 2.4. Research questions and hypotheses related to school middle-leaders

Research question	Hypothesis
RQ1a. What is the nature of the changes in middle-leaders' knowledge and beliefs about SRL in response to a PLC-ER about SRL?	H1a. Changes in middle-leaders' knowledge and beliefs about SRL in response to a PLC-ER about SRL will be qualitative and quantitative (i.e., path of change), slow (i.e., rate of change), domain-specific (i.e., breadth of change), substantially vary across similar tasks and middle-leaders (i.e., variability of change) and be in

Research question	Hypothesis
	response to participation in a PLC-ER about SRL (i.e., source of change).
RQ1b. Are the changes in middle-leaders' knowledge and beliefs about SRL sustained over time?	H1b. Changes in middle-leaders' knowledge and beliefs about SRL in response to a PLC-ER about SRL will be sustained over time.
RQ2a. What is the nature of the changes in middle-leaders' epistemic reflexivity about SRL in response to a PLC-ER about SRL?	H2a. Changes in middle-leaders' epistemic reflexivity about SRL in response to a PLC-ER about SRL will be qualitative and quantitative (i.e., path of change), slow (i.e., rate of change), domain-specific (i.e., breadth of change), substantially vary across similar tasks and middle-leaders (i.e., variability of change) and be in response to participation in a PLC-ER about SRL (i.e., source of change).
RQ2b. Are the changes in middle-leaders' epistemic reflexivity about SRL in response to a PLC-ER about SRL sustained over time?	H2b. Changes in middle-leaders' epistemic reflexivity about SRL in response to a PLC-ER about SRL will be sustained over time.
RQ3a. If yes, what is the nature of the changes in middle-leaders' teaching practice about SRL in response to a PLC-ER about SRL?	H3a. Changes in middle-leaders' teaching practice about SRL in response to a PLC-ER about SRL will be qualitative and quantitative (i.e., path of change), slow (i.e., rate of change), domain-specific (i.e., breadth of change), substantially vary across similar tasks and middle-leaders (i.e., variability of change) and be in response to participation in a PLC-ER about SRL (i.e., source of change).
RQ3b. Are the changes in middle-leaders' teaching practice about SRL in response to a PLC-ER about SRL sustained over time?	H3b. Changes in school middle-leaders' teaching practice about SRL in response to a PLC-ER about SRL will be sustained over time.

As argued in Section 1.2, the sustainability of school improvement initiatives is the result of dynamic interactions of the Complex Adaptive System, one part being the school middle-leaders. Changes that emerge in school middle-leaders' epistemic cognition have potential to stimulate changes in other parts of the system (as discussed at 1.3). It is as Schneider and Somers (2006) stated "leadership might come to affect other variables as well, in the iterative interactions of variables which characterise dynamic systems" (p. 352). Table 2.5 documents the research questions and hypotheses related to teachers and Table 2.6 documents the research questions and hypotheses related to students.

Table 2.5. Research questions and hypotheses for teachers

Research question	Hypothesis
RQ4a. Do regular classroom teachers' beliefs about SRL change in response to middle-leaders' PLC-ER about SRL?	H4a. Regular classroom teachers' beliefs about SRL will change in response to a middle-leaders' PLC-ER about SRL.
RQ4b. If yes, what is the nature of the changes in regular classroom teachers'	H4b. Changes in regular classroom teachers' beliefs about SRL in responses to a middle-leaders' PLC-ER about SRL will be quantitative (i.e., path of change), slow

Research question	Hypothesis
beliefs about SRL in response to a middle-leaders' PLC-ER about SRL?	(i.e., rate of change), domain-specific (i.e., breadth of change), substantially vary across similar tasks and teachers (i.e., variability of change) and be in response to a middle-leaders' PLC-ER about SRL intervention (i.e., source of change).
RQ4c. Are the changes in regular classroom teachers' beliefs about SRL in response to a middle-leaders' PLC-ER about SRL sustained over time?	H4c. Changes in regular classroom teachers' beliefs about SRL in response to a middle-leaders' PLC-ER about SRL will be sustained over time.

Table 2.6. Research questions and hypotheses for students

Research question	Hypothesis
RQ5a. Do students reported SRL behaviours change in response to a middle-leaders PLC-ER about SRL?	H5a. Students reported SRL behaviours will change in response to a middle-leaders' PLC-ER about SRL.
RQ5b. If yes, what is the nature of the changes in students reported SRL behaviours in response to a middle-leaders' PLC-ER about SRL?	H5b. Students will report enhanced SRL after the middle-leaders' PLC-ER about SRL.
RQ5c. Are the changes in students' SRL in response to a school middle-leaders' PLC-ER about SRL sustained over time?	H5c. Changes in students reported SRL behaviours in response to a middle-leaders' PLC-ER about SRL, will be sustained over time.

2.8.3. Variables

Independent variable:

- PLC-ER about SRL.

Dependent variables:

- School middle-leaders' epistemic cognition, with a particular focus on their knowledge and beliefs, epistemic reflexivity and teaching practice about SRL.
- Teachers' beliefs about SRL.
- Students' SRL.

3. METHOD

This chapter outlines the research design, methodology and methods used for collecting data in the present study, including ethical considerations, participant selection and recruitment processes. In additional, the approach to the data analysis used to answer the research questions is detailed.

3.1. Research Design

This section details and justifies the chosen research design, including ontological and epistemological stances, methodological approach and methods (data collection, data analysis).

3.1.1. Research paradigm

The idea that a researcher operates from a chosen paradigm has been a prominent and widely accepted argument for many years. *Research paradigms* were first proposed by T. S. Kuhn (1962, 1970) in the context of normal science. More recently, a *research paradigm* has been defined as "a general organising framework for theory and research that includes basic assumptions, key issues, models of quality research, and methods for seeking answers" (Neuman, 2014, p. 96). I understand a *research paradigm* as a system of beliefs, assumptions, ideas and research techniques, predetermined by a scientific community that guides how scientists conduct their research (Levers, 2013; Van de Ven, 2007). It represents views on what reality is (ontological stance), beliefs about what knowledge is and how it is justified (epistemic beliefs), the overarching approach to selecting research methods (methodological approach) and the technical research procedures (methods). Therefore, the *research paradigm* from which a researcher operates, whether tacit or explicit, inevitably influences how they identify problems, generate questions, and collect, analyse and interpret data.

Researchers have attempted to synthesise available paradigms into more succinct categories. For example, Van de Ven (2007) categorized paradigms under the umbrellas of positivism, relativism, realism and pragmatism, Neuman (2014) documented three main paradigms; positivism, interpretivism and critical theory, while Levers (2013) separated the ontological perspectives of positivism and critical realism from the postpositivist, interpretivist and constructionist paradigms. According to Van de Ven (2007) understanding the various paradigms is "a useful first step in appreciating, selecting, and possibly synthesizing a philosophy of science that overcomes some of the concerns and criticism of contemporary sceptics and hopefully initiates a process of reflexivity" (p. 40). Likewise, Levers (2013) advocated that the selection of

(and therefore alignment between) a paradigm and a researcher's own beliefs was a precursor to a strong research design.

Based on these recommendations, critical reviews of positivism, relativism, critical realism and pragmatism, are presented in the following subsections.

Positivism

Positivism is a prominent research paradigm often associated with the natural sciences. It focuses on identifying causal mechanisms by using empirical methods (Mertens, 2010; Neuman, 2014; Van de Ven, 2007). Ontologically and epistemologically, positivists are objective, defining reality as "independent of cognition" (Van de Ven, 2007, p. 38). They place a rigid emphasis on knowledge drawn from careful scientific investigations (e.g. randomised controlled trials) and discount the practical outcomes of other forms of investigations (e.g., case studies). When applied to the context of education, positivists argue a causal link between environmental factors and behavioural factors. As Neuman (2014) stated, it is a "mechanical model of man… [and suggests] that people respond to external forces that are as real as physical forces on objects" (p. 98). As such, positivists would deny that schools are Complex Adaptive Systems engaged in a continuous, dynamic and non-linear process of improvement, whereby changes are emergent and unpredictable. Moreover, positivists disregard the role of personal factors such as knowledge, beliefs and motivations (a key aspect of Bandura's model of reciprocal determinism, and one of the theoretical frameworks underpinning the present study) in the shaping of behaviour. From the positivist paradigm, the process of epistemic cognition for teaching about SRL would have little to no influence on the sustainability of school improvement initiatives about SRL. Indeed, it contradicts the notion of agency and the argument that middle-leaders, and equally teachers, make decisions about how they enact knowledge about SRL or not. Indeed, Cziko (1989) pointed out that two of the strongest arguments against a positivist/deterministic (i.e., causal) view for educational research is that it ignores individual differences and 'chaos', two components that are inherent to Complex Adaptive Systems. As a social science, educational research is an "intensely human social process" (Van de Ven, 2007, p. 37) influenced by various personal and environmental factors (e.g., biases, culture, language, social norms). Therefore, it is unrealistic to expect complete objectivity, as is the positivist way. Bandura (1978) argued that positivists and the associated methods of natural science were "incapable of dealing with personal determinants of behaviour" (p. 345). This is pertinent to the present study that has a large focus on the personal process of epistemic cognition for teaching about SRL.

Relativism

Relativism emerged in direct opposition to positivism, and has been used as an umbrella term for a range of paradigms (i.e., historical relativism, social constructivism, postmodernism, interpretivisim, critical theory and hermeneutics). Ontologically, relativists place emphasis on a subjective and socially constructed reality, acknowledging the personal factors that influence truth and behaviour, making the paradigm more attractive to researchers studying educational phenomena (e.g., epistemic cognition for teaching). However, according to Levers (2013), relativists hold 'the belief that… nothing exists outside of [an individual's] thoughts' (p. 2), essentially denying an objective reality, and ignoring the role that environmental factors play in the shaping of behaviour. This is further supported by Bandura's (1978) argument – "to contend that mind creates reality fails to acknowledge that environmental influencers partly determine what people attend to, perceive, and think" (p. 354). Epistemologically, relativists believe that knowledge of this reality does not exist in data itself, but in the personal and social construction and interpretation of the data (Van de Ven, 2007). It is as Levers (2013) stated 'with multiple interpretations of experience come multiple realities' (p. 2). Indeed, the acceptance of each person's subjective reality, what Van de Ven (2007) referred to as an ''anything goes' ethical connotation' (p. 40), is one of relativism's biggest criticisms. While relativism offers greater alignment with educational research due to its acknowledgement of personal factors and the subjective experience, operating purely from a relativist perspective ignores the role of the environment.

Critical Realism

Critical realism is considered a 'contemporary uptake of the realist ontological perspective' (Levers, 2013, p. 2) and exists between the extremes of relativism and positivism. Like positivists, critical realists believe in an objective reality – that there is a reality that exists independent of the mind. Indeed, as Van de Ven (2007) argued – an objective reality is "a precondition of empirical inquiry" (p. 60). However, like relativists, critical realists acknowledge the role of subjective interpretations in the process of identifying this objective reality. Thus, researchers operating from the critical realist paradigm understand the fallibility of knowledge (i.e., there are no absolute truths), but place value on empirical investigations in their attempts to gain accuracy and clarity in knowledge (Neuman, 2014). Greene et al. (2016) who are prominent researchers in the field of epistemic cognition have clarified this as:

> [Critical realists] believe that while it may be the case that humans will never be able to obtain a perfect mental representation of this 'real' world [i.e., objective reality], humans can construct increasingly productive and useful models of that world, which they call 'knowledge'. For these scholars, a particular human's understanding of reality may never be perfect, but it is nonetheless useful and therefore warrants being called 'knowledge' (Greene et al., 2016, p. 4).

Critical realism also shares similarities with Bandura's (1978, 2001) model of reciprocal determinism (i.e., a theoretical framework for present study) making it a suitable research paradigm for the present study. For example, as opposed to Positivists who emphasise observations to explain human responses, critical realists recognise that only the outcomes of processes can be documented through observation, not the process itself (Levers, 2013). This is because critical realists believe that both environmental and personal factors play a role in the determination of behaviour responses, and therefore not all factors are directly observable (e.g., epistemic cognition for teaching). Indeed, Levers (2013) argued that "observation of an entity is not required to determine whether it exists" (p. 2.), and such is the case with investigations into school middle-leaders' epistemic cognition for teaching. It may not be possible to directly observe processes such as sustainability or epistemic cognition for teaching; however, it is possible to use empirical observations of changes in structures or behaviours to better understand these processes.

Pragmatism

Critical realism is arguably connected to pragmatism (Archer, 2010b), an American philosophical school of thought, that also arose as a substitute to positivism. Some of the well-known pragmatists (e.g., Peirce, James, Dewey) all adopted a realist ontological stance (i.e., objective reality), but also acknowledge the role of subjective interpretations of that reality. For example, Peirce (1878) stated:

> There are real things [i.e., objective reality], whose characters are entirely independent of our opinions about them; those realities affect our senses according to regular laws, and, though our sensations are as different as our relations to the objects, yet, by taking advantage of the laws of perception, we can ascertain by reasoning how things really are [i.e., truth] (Peirce, 1878, p. 21).

Peirce (1878) introduced the term 'pragmatism' (origin: Greek word 'action') as a paradigm that sought truth in the practical effects of our conceptions. For example, truth about the role of epistemic cognition for teaching for sustainability exists in the changes within a school, or future implications of results from the present study. This is an important driver of the present research study, the practical effects that result from the inquiry. Recent pragmatic theorists (for example, Hammond, 2013; Scott, 2016) have continued to explain that pragmatism is an approach that views knowledge as the result of practical, concrete effects of actions.

From a critical realist paradigm, I acknowledge that truth regarding sustainability and epistemic cognition for teaching exists (i.e., ontology: an objective reality), albeit difficult to grasp. Furthermore, within a combined relativist/pragmatic epistemology paradigm (i.e., subjective

interpretations, knowledge is fallible, truth [i.e., knowledge] exists in the practical outcomes of ideas), I recognise that it is through empirical investigations coupled with individual or shared reasoning (i.e., social constructivism), that I can gain a better understanding of what this reality is. Adopting a critical realist paradigm enables a suitable exploration of sustainability and epistemic cognition for teaching. In doing so, researchers can begin to anticipate the types of conditions that may better support or hinder sustainability of school improvement initiatives.

3.1.2. Methodological approach

Understanding how change occurs is a central issue in the field of cognitive psychology (Flynn, Pine, & Lewis, 2006; Siegler, 1995) and is a fundamental concern of the present study. Indeed, Hofer (2018) stated that "[epistemic cognition] research needs to focus on the process of change… yet current methods tend to capture outcomes more than process" (p. 233). A microgenetic approach and pre-post design were chosen as suitable methodological approaches to evaluate the process of change while it occurred and any observed changes that emerged over time.

The microgenetic approach "involves taking repeated measurements from the same participants over the course of transition in the domain of interest" (Flynn et al., 2006, p. 152), and produces insights into the process of learning that occurs. There is consensus that the microgenetic method is observing change as it transpires, and researchers utilising the microgenetic approach aim to illuminate the substructures and mechanics of change (Flynn et al., 2006). The term *microgenetic* was first introduced by Werner (1956) in a series of experiments that considered the nuanced changes in psychological states. 'Genetic' refers to the origin of the change (i.e., genesis), while 'micro' highlights the fine-grained focus on the minor transitions. The microgenetic approach shares similarities with Piaget's (1970a) program of research regarding genetic epistemology (i.e., origin of knowledge), but also stems back to Vygotsky's (1930, 1978) work whereby he advocated for a micro-focus on the process of learning and development (i.e., change). Siegler and Crowley (1991) and then Siegler (2006) suggested the microgenetic approach is defined by 3 key characteristics: (1) Observations (i.e., data collection points) occur from beginning to end of the change period, (2) The number of observations must be high in relation to the rate of change, and (3) Observations are thoroughly analysed to identify the process of change that has occurred. Although the wording of these characteristics has changed slightly over time [e.g., "[2] observations span as large a portion as possible of the period during which rapid change in the particular competence occurs" (Siegler, 1995, p. 226)], the meaning of each characteristic has essentially stayed the same since Siegler and Crowley's first mention of them and many researchers have documented these characteristics as defining characteristics of the microgenetic approach (Chinn & Sherin, 2014; Flynn et al., 2006; Siegler, 2006).

The study of change has typically occurred using cross-sectional approaches (Winne & Nesbit, 2010), or longitudinal approaches, but these methodologies alone fall short in their ability to explain the process of learning (Chinn & Sherin, 2014). For example, longitudinal pre-post designs evaluate change by comparing two or more assessments over an extended period (e.g., 1-3 years) and reveal an overview of changes (Postlewaite, 2005), whereas a microgenetic approach collects data more frequently and focuses on the fine-grained effects that occur during a process of change. Longitudinal studies take repeated measurements over time, but with substantial gaps between data collection points and, as a result, assessments tend to describe the observed change itself as opposed to the process of change. Additionally, according to Flynn et al. (2006) "conventional cross-sectional and longitudinal studies focus on group data and treat individual variation as statistical noise" (p. 152), whereas the microgenetic method acknowledges the value in this individual variation for explaining the underlying mechanisms of change.

Additionally, a microgenetic approach enables a depth of understanding in a specific context. Schools are unique, shaped by various factors such as location, nature of discipline, cultural expectations, student population and government mandates. Researchers need to carefully consider such different contextual conditions and continuously evaluate interventions within these contexts, as the success of an intervention in one school does not necessarily guarantee success in another (Avalos, 2011).

In order to conduct a comprehensive microgenetic investigation into teachers' epistemic cognition about explicit teaching of SRL strategies, I chose a convergent mixed methods design (Creswell, 2014). Quantitative and qualitative methodologies carry their own strengths and weaknesses, and a mixed method design allows "one data collection form [to supply] strengths to offset the weaknesses of the other form" (Creswell, 2014, p. 570). For example, quantitative methods such as closed-ended questionnaires are easily distributed, gather data from large samples, and can be quickly processed and analysed. Additionally, they are typically systematic with a high degree of precision and control (Coolican, 1995) and can be used across different levels of participants enabling the possibility for comparison within and between groups. However, such quantitative measures can limit insights about psychological phenomena such as teachers' epistemic cognition (Martin, Marsh, Williamson, & Debus, 2003). Qualitative methods such as open-ended questionnaires can generate extensive data related to components of epistemic cognition, but typically require greater time for both data collection and data analysis (Creswell, 2018). Researchers (for example, Greene & Yu, 2014; Hofer, 2006) have admitted difficulties in measuring epistemic cognition solely using common self-report mechanisms such as questionnaires, suggesting the inclusion of process measures such as audio-recorded thinking-aloud or more objective measures such as video-recorded lesson observations. Both

these process measures were included in the convergent mixed methods design adopted in the present study. Please note that data collection methods are detailed later in this chapter.

Finally, to assess emergent changes, beyond the conclusion of the PLC-ER about SRL, I used a pre-post research design (Postlewaite, 2005), collecting data from all participant groups before the middle-leaders' PLC-ER about SRL (Week 0), immediately after the middle-leaders' PLC-ER about SRL (Week 12) and again 9 months after the middle-leaders' PLC-ER about SRL (Week 52). The selected time-delay of nine months reflected other intervention studies (for example, Gaikhorst et al., 2017) and was achievable within the scope of this doctoral research project.

The chosen methodology enables a deep investigation into the underlying mechanisms of change that emerges in middle-leaders' epistemic cognition and practice as they engaged in a researcher-facilitated PLC-ER about explicit teaching of SRL strategies. The following sub-section outlines my own professional/research background, prior to then outlining details of the study participants.

3.2. Researcher Background

Between the years 2007 to 2014, I worked as a secondary school teacher and in the role of a school middle-leader across three different schools including the participating school. My middle-leader roles were within the area of teacher professional education, learning strategies, literacy, numeracy and special education. As a middle-leader, I observed a potential gap in teachers' professional competence in promoting SRL in the classroom, and the critical role that teachers' knowledge and beliefs about learning played in the promotion of SRL strategies in the classroom.

This prior experience contributed to my intrinsic motivation during the completion of this study. At times, this prior experience prompted me to hold a deficit view of school middle-leaders' competence about SRL which was managed through consistent self-observation and self-talk, and re-calibration of my own beliefs through conversations with fellow researchers. For example, when I recognised, through my own meticulous reflective thinking, that I was adopting a deficit view (e.g., 'the school middle-leaders lack competence'), I used a self-question mechanism such as 'are the teachers actually incompetent or are there other reasons underlying their decisions/behaviour?'.

Specifically, during the years of 2013-2017, I completed a Master of Education specialising in Cognitive Psychology and Educational practice, including a research dissertation that explored changes in four science teachers' epistemic cognition about SRL as they participated in a PLC about SRL. During this time, I received training in qualitative data collection and data analysis methods including coding procedures. I used this prior knowledge of qualitative methods to help

develop effective coding procedures used in the present study. More so, the present study was designed to mitigate limitations identified during my Master's dissertation and responds to a key finding – that teachers reported the likelihood of continued implementation was dependent on leadership.

Researcher-participant relationship

No conflict of interest was identified between supervisor, researcher and participants. The present study required me to fulfil the roles of *researcher*, collecting data before, during, immediately after and 9-months after the PLC-ER about SRL, and *facilitator* of the PLC-ER about SRL.

Facilitation of the PLC-ER about SRL with the school's middle-leaders was funded by the school. A funded professional education program (i.e., PLC-ER about SRL) can carry an expectation of learning outcome success; however, in my conversations with the Deputy Principal at the school, no such success was guaranteed.

The mandate from the school was that all school middle-leaders (n=19) participated in the professional education sessions, but not the audio-recorded thinking-aloud or the video-recorded observations. Any involvement in the data collection components was completely voluntary. To mitigate any feeling of participant coercion in the data collection components, voluntary participation was verbally emphasised with repetition throughout all participant recruitment conversations. The number of consenting middle-leaders (n=16) compared with the available pool (n=19) suggested that middle-leaders understood the distinction between my role as a *researcher* and my role as a *facilitator* of the professional education sessions.

3.3. Participant Recruitment

This section details the process of participant selection and recruitment.

3.3.1. Participant selection and school context

Schools in Australia cannot be compelled to participate in a research project, so convenience sampling was used. The research site was an Independent Girls School in the Melbourne metropolitan area. There were approximately 1000 students enrolled from the Early Learning Centre through to Year 12, and over 250 staff (including ~150 teaching staff). Most importantly, the school has demonstrated interest in SRL over a number of years. For example, in 2013-2014, the school funded 8 teaching staff members to study a Graduate Certificate of Education (Cognitive Psychology and Educational Practice), a tertiary course that focuses on many aspects of SRL (e.g., motivation, cognition and metacognition). In 2016, the school funded 20 teaching staff to participate in five 2-hour workshops that also focused on aspects of SRL (e.g., metacognition). In 2017, the school introduced a new student program that emphasised student independent

learning, and acknowledged that further investment in professional education would be a useful way forward. Leveraging the chosen school's interest, and an already developed productive working relationship, I approached 19 middle-leaders, 110 teachers and 818 Years 5-12 students from an independent school in Melbourne to participate. Data was collected during Semester 1 of the 2018 school year and then again during Term 1 of the 2019 school year.

3.3.2. Recruitment process

Recruitment of school middle-leaders

At a school middle-leaders' team meeting, I read a verbal script inviting participation (Appendix A) and then, during the meeting, I emailed each middle-leader with a letter of introduction (Appendix B), information sheet (Appendix C) and consent form (Appendix D). I emphasised that if the middle-leaders chose not to participate, data related to their epistemic cognition or their teaching practice would not be collected or reported.

Recruitment of regular classroom teachers

I provided the Deputy Principal (delegate of the Principal) of the school with a verbal script inviting teacher participation (Appendix A). The Deputy Principal read the verbal script to the teachers during an all-staff meeting at the school. Following this, a school administrative support staff member forwarded an email (Appendix E) to all teachers with a letter of introduction (Appendix B), an information sheet (Appendix C) and the link to the questionnaire. Consent was implied via completion of the questionnaire.

Recruitment of school middle-leaders' students

I visited each participating school middle-leaders' selected classes and read a verbal script (Appendix A) that explained the research project to the students. I emphasised that if students chose not to participate in the study I would not collect any data from them and they would still have access to the new SRL teaching approaches. Each middle-leader forwarded to all students in their selected class a student information package containing an email (Appendix E), a letter of introduction (Appendix B), an information sheet (Appendix C) and a consent form (Appendix D). Following this, a school support staff emailed all parents/carers of students in selected classes a parent/carer information package, including a letter of introduction (Appendix B), an information sheet (Appendix C) and a parental consent form (Appendix D).

Recruitment of regular classroom teachers' students

On my behalf, teachers read a verbal script (Appendix A) that explained my research project to their students. Each teacher forwarded to their students a student information package containing an email (Appendix E), a letter of introduction (Appendix B), an information sheet (Appendix C)

and a link to the online student questionnaire. Consent was implied via completion of the questionnaire. A school support staff member emailed all parents/carers of students a parent/carer information package, including a letter of introduction (Appendix B), an information sheet (Appendix C) and a parental consent form (Appendix D).

3.4. Ethics

Ethics approval was granted by the Flinders University Social and Behavioural Research Ethics Committee (Project number: 7863, Appendix G). No incentives were used to encourage participation; however, recognition was provided to school middle-leaders, regular classroom teachers and students for time spent completing questionnaires immediately after and 9-months after completion of the school middle-leaders' PLC-ER about SRL. To reimburse middle-leaders, regular classroom teachers and students for time spent completing the second and third round of questionnaires, middle-leaders and regular classroom teachers, and separately students, were entered into Lucky Number Draws to win a $50 iTunes gift voucher. The allocation of a 'Lucky Number' (the chosen winner) was a random and de-identified process, and participants were entirely free to decide whether they wished to complete the questionnaires or not. A detailed procedure is included as Appendix H.

Confidentiality and anonymity of school middle-leader questionnaire, think-aloud and classroom observation data

To protect school middle-leaders' identity, their school staff identification numbers (e.g., 52348) were replaced with general identification numbers (e.g., ML1, ML2). Any demographic information or context specific terms that could reveal the identity of the school middle-leader or the school were either omitted or replaced with equivalent more generic terms (e.g., subject coordinator). All school middle-leaders' responses were confidential; however, complete anonymity could not be guaranteed as other school middle-leaders involved in the PLC-ER about SRL may have been aware of the identity of the other participating school middle-leaders. All school middle-leaders were reminded during the professional education sessions to respect the voluntary participation of others involved and to not disclose the names of those participating.

Confidentiality and anonymity of teacher questionnaire data

To protect regular classroom teachers' identity, their school staff identification numbers (e.g., 52348) were replaced with general identification numbers (e.g., T1, T2). Any demographic information or context specific terms that could reveal the identity of the regular classroom teacher or the school were either omitted or replaced with equivalent more generic terms (e.g. subject coordinator). All regular classroom teachers' responses were confidential.

Confidentiality and anonymity of students' SRL Process Protocols data and questionnaire data

Similarly, to protect students' identity, their school student identification numbers (e.g., 52348) were replaced with general identification numbers (e.g., S1, S2). Any demographic information or context specific terms that could reveal the identity of the student or the school were either omitted or replaced with equivalent more generic terms. All students' responses were confidential.

3.5. Participant Demographic Information

In this section, I report demographic data for each of the participant groups, namely school middle-leaders, regular classroom teachers and students. Furthermore, I also document the middle-leaders' participation rates in the PLC-ER about SRL. An overview of all participants' demographic information is represented in Table 3.1.

Table 3.1. Overview of participant demographic information

Participant group	Available participant pool	Consenting participants	Percentage of available pool	Gender (Female)	Age range
School middle-leaders	19	16	84%	11	25-50+
Regular classroom teachers	110	22	20%	19	25-50+
Students	818	305	37%	305	9-18

From Table 3.1, 84% of available middle-leaders participated in the primary component of this study, a substantial representation of the available pool. Participation of regular classroom teachers (20%) and students (37%), who comprised the secondary component of this study (downstream effects) was substantially lower when compared with their representative pools. All students were female as the school was an all-girls school. Note here again that the main participant pool (teachers) were of mixed gender, and the target school was selected due to its availability and interest in SRL. The single sex nature of the student participant group is further addressed in the Limitations section of this thesis.

One explanation for the differences in participation may be my attendance. I attended one middle-leader meeting and the related middle-leader classes to provide the necessary information and to invite participation. The other participant groups were read a verbal script by a school representative. Although I read a similar script in my recruitment meetings, it is possible that my enthusiasm was higher than other school representatives, potentially influencing participant signup. Another reason is that the main participant group – middle leaders stood to gain more

directly from their engagement in my research through their involvement in the professional education component of my study. The participants engaged in the downstream effects study (students and regular teachers) would be involved in data collection only and potentially could envisage less value for their engagement in my research project. This issue is also further addressed in the Limitations section of this thesis.

3.5.1. School middle-leader demographic information

School middle-leaders' demographic information is documented in Table 3.2.

Table 3.2. School middle-leader demographic information

Participant ID	Year levels taught	Years teaching experience	Highest qualification	Prior professional development in field of SRL or similar
ML1	Primary	11+	Bachelor's degree	Yes (Learning Strategies, Special Education)
ML2	Primary	6-10	Bachelor's degree	Yes (Learning Strategies)
ML3	Primary	11+	Master's degree	No prior professional development in the field of SRL or similar
ML4	Secondary	6-10	Bachelor's degree	Yes (SRL, Cognitive Psychology)
ML5	Secondary	11+	Bachelor's degree	Yes (Learning Strategies)
ML6	Secondary	6-10	Master's degree	Yes (Learning Strategies, Special Education)
ML7	Secondary	11+	Bachelor's degree	Yes (Learning strategies, Special Education)
ML8	Secondary	11+	Bachelor's degree	Yes (SRL, Learning strategies, Special Education)
ML9	Secondary	6-10	Master's degree	Yes (SRL, Cognitive Psychology, Learning Strategies, Metacognition)
ML10	Secondary	11+	Master's degree	Yes (Learning Strategies)
ML11	Secondary	6-10	Master's degree	No prior professional development in the field of SRL or similar
ML12	Secondary	11+	Bachelor's degree	Yes (Learning Strategies)
ML13	Secondary	6-10	Master's degree	Yes (Cognitive Psychology, Learning strategies, Metacognition)
ML14	Secondary	11+	Master's degree	No prior professional development in the field of SRL or similar

Participant ID	Year levels taught	Years teaching experience	Highest qualification	Prior professional development in field of SRL or similar
ML15	Secondary	11+	Bachelor's degree	Yes (Learning strategies, Special Education)
ML16	Secondary	11+	Master's degree	Yes (Cognitive Psychology, Learning strategies, Metacognition, Special Education)

Table 3.2 indicates that all participating middle-leaders (n=16) had at least 6 years' teaching experience and were serving in a middle-leadership role during the implementation of the PLC-ER about SRL and the data collection period. Middle-leadership roles were subject coordinator/head of faculty roles (e.g., English coordinator, Head of Science). All middle-leaders were suitably qualified to teach and registered with the Victorian Institute of Teaching (VIT). When considering the year levels that middle-leaders typically taught (refer light grey column in Table 3.2), three middle leaders reported being primary focussed (Years 5 and 6), with the remaining 13 middle-leaders teaching the secondary year levels of Years 7-12. In Table 3.2, the "Prior professional development" (orange) column details that 13 middle-leaders reported having already undertaken professional education in the field of SRL or similar, with only ML3, ML11 and ML14 indicating that they had not been involved in professional education about SRL or similar.

3.5.2. Regular classroom teacher demographic information

Regular classroom teachers' demographic information is documented in Table 3.3.

Table 3.3. Regular classroom teacher demographic information

Participant ID	Year levels taught	Years teaching experience	Highest qualification	Prior professional development in the field of SRL or similar
T1	Secondary	6-10	Master's degree	Yes (SRL, Cognitive Psychology, Learning Strategies)
T2	Secondary	11+	Bachelor's degree	Yes (Learning strategies)
T3	Secondary	3-5	Master's degree	Yes (Learning strategies)
T4	Secondary	11+	Bachelor's degree	Yes (Cognitive Psychology, Learning Strategies, Special Education)
T5	Secondary	3-5	Bachelor's degree	No prior professional development in the field of SRL or similar
T6	Secondary	6-10	Master's degree	Yes (Learning Strategies)

Participant ID	Year levels taught	Years teaching experience	Highest qualification	Prior professional development in the field of SRL or similar
T7	Secondary	11+	Diploma of Education	Yes (SRL, Cognitive Psychology, Learning Strategies, Special Education)
T8	Secondary	11+	Bachelor's degree	No prior professional development in the field of SRL or similar
T9	Secondary	6-10	Bachelor's degree	Yes (Learning strategies, Special Education)
T10	NA	11+	Master's degree	Yes (SRL, Learning Strategies, Special Education)
T11	Primary	3-5	Master's degree	Yes (Learning strategies, Special Education)
T12	Secondary	11+	Bachelor's degree	Yes (Cognitive Psychology, Learning Strategies, Special Education)
T13	Secondary	6-10	Master's degree	Yes (SRL, Learning Strategies, Special Education)
T14	Secondary	1-2	Master's degree	No prior professional development in the field of SRL or similar
T15	Secondary	NA	NA	Yes (Learning strategies, Special Education)
T16	Primary	11+	Diploma of Education	Yes (Cognitive Psychology, Learning Strategies, Special Education)
T17	Secondary	6-10	Master's degree	Yes (Cognitive Psychology, Learning Strategies, Special Education)
T18	NA	11+	Bachelor's degree	No prior professional development in the field of SRL or similar
T19	Secondary	1-2	Doctorate	Yes (Learning strategies)
T20	Secondary	1-2	Master's degree	Yes (Learning strategies, Special Education)
T21	Secondary	11+	Master's degree	Yes (Learning strategies)
T22	Secondary	11+ years	Master's degree	Yes (Cognitive Psychology, Learning Strategies, Special Education)

Table 3.3 indicates that all participating regular classroom teachers (n=22) had a broad range of types of teaching experience (1 to 11 or more years). All regular classroom teachers were registered with the Victorian Institute of Teaching (VIT) and were therefore suitably qualified to

teach. Eighteen of the teachers reported having already undertaken professional education in the field of SRL or similar.

3.5.3. Student demographic information

Students' demographic information is documented in Table 3.4.

Table 3.4. Student demographic information

Year level	Participants	Age range	School level
Year 5	22	9-11	Primary
Year 6	26	10-11	Primary
Year 7	54	11-13	Secondary
Year 8	51	12-14	Secondary
Year 9	43	13-15	Secondary
Year 10	60	14-16	Secondary
Year 11	24	15-17	Secondary
Year 12	25	16-18	Secondary

Table 3.4 indicates that the majority of student participants were in Years 7 through 10 aged from 11 to 16 years of age. Years 5 and 6 are primary and 7 through 12 are secondary levels of schooling at the research site. As this was a single-sex school, all student participants were female.

3.5.4. School middle-leader attendance rates

The intervention in this study comprised a researcher-led PLC, which focused upon developing middle-leaders' epistemic reflection (PLC-ER) about SRL. The intervention consisted of 33 components (e.g., attendance at each professional education session, submission of audio-recorded thinking-aloud). Table 3.5 reports school middle-leaders' participation in the PLC-ER about SRL.

Table 3.5. Attendance at PLC-ER components by middle-leaders

Participant ID	Attendance: PLC-ER components (%)
ML1	18 (55%)
ML2	30 (91%)
ML3	17 (52%)
ML4	28 (85%)
ML5	25 (76%)

Participant ID	Attendance: PLC-ER components (%)
ML6	14 (42%)
ML7	22 (67%)
ML8	29 (88%)
ML9	29 (88%)
ML10	27 (82%)
ML11	20 (61%)
ML12	8 (24%)
ML13	18 (55%)
ML14	11 (33%)
ML15	12 (36%)
ML16	11 (33%)
Mean	20 (60%)

Table 3.5. demonstrates that middle-leaders' attendance (involvement, engagement or completion) in the PLC-ER about SRL varied greatly. Discussions with participants indicated that typical reasons for disengagement were personal and work commitments. For example, ML5 (76%) worked part-time and was unable to attend three of the five professional education sessions due to family commitments, while ML12 (24%) only attended the professional education sessions and did not record think aloud-protocols or engage in lesson observations. On average, school middle-leaders attended and/or completed 60% of the components of the PLC-ER about SRL, with a range of 24% to 91%.

Variable participation is a common, and arguably unavoidable occurrence in studies in naturally occurring educational contexts (i.e., open systems; refer Section 1.1). However, the substantial amount of data collected from middle-leaders over time provided a sufficient range of contextually valid perspectives to enable thematic and numerical analysis.

3.6. Experimental Intervention

Building on the literature reviewed in section 2.6.3, I designed a PLC-ER about SRL as the experimental intervention for my study. The PLC-ER about SRL was only available to school middle-leaders, not regular classroom teachers or students. Figure 3.1 provides a brief overview of the PLC-ER.

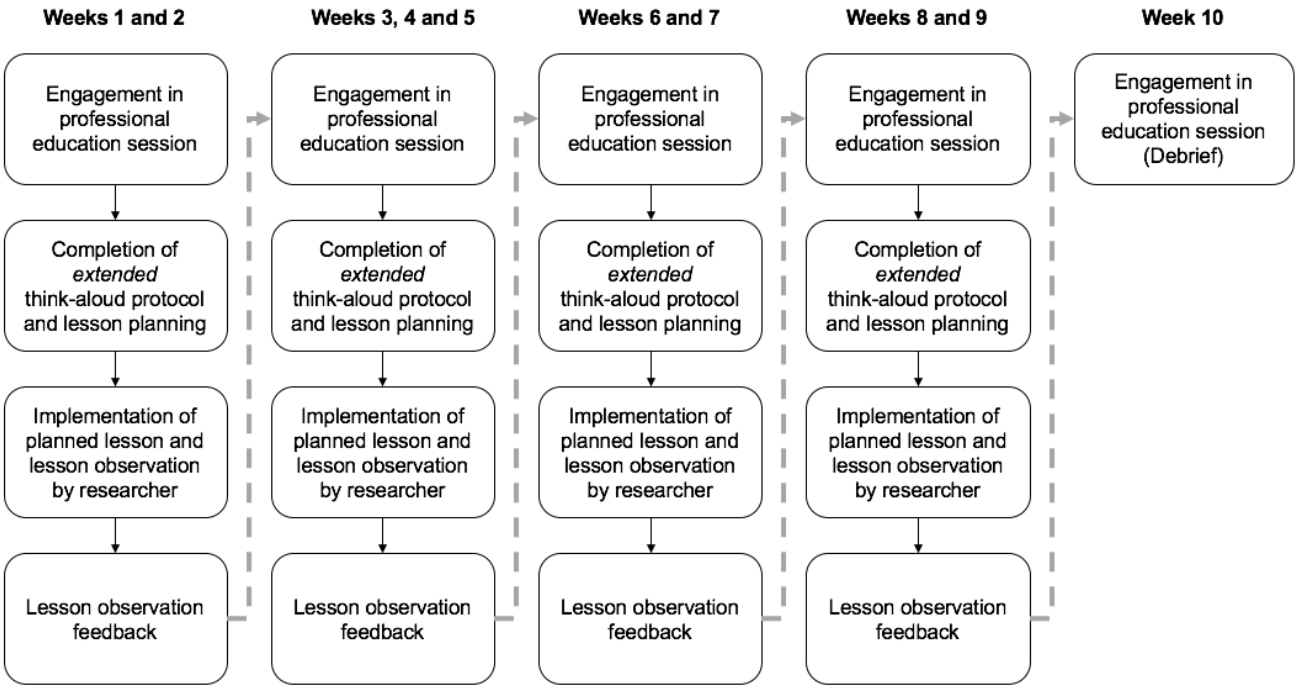

Figure 3.1. Overview of middle-leaders' PLC-ER about SRL

3.6.1. Professional education sessions

Figure 3.1 illustrates that middle-leaders were invited to engage in five 2-hour professional education sessions occurring approximately fortnightly over a ten-week period. These sessions occurred during Semester 1 of the 2018 school year. Professional education sessions comprised of a workshop and a recording participants' thinking-aloud while completing a lesson planning activity.

Workshop

During the first 90 minutes of the 2-hour professional education session, middle-leaders were encouraged to reflect on their classroom practice about SRL, engage in collaborative discussions and construct new knowledge about evidence-based SRL teaching approaches. An overview of content of the professional education sessions is documented in Table 3.6. More detailed outlines of the professional education sessions are attached as Appendix M. Materials discussed during the professional education sessions (e.g., readings, videos, images of created concept maps) were uploaded to the school learning management system for later access.

Table 3.6. Overview of workshops

Session	Title	Description	Supporting theory
1	Defining SRL	Unpacked notion of a PLC, including setting of norms/expectations for the PLC. Additionally, required school middle-leaders to activate prior knowledge about SRL and attempt to develop a shared definition for SRL. Zimmerman's (2002)	PLCs (Bowe & Gore, 2016; DuFour & Eaker, 1998)

Session	Title	Description	Supporting theory
		process model of SRL was discussed as one of the popular frameworks for understanding SRL.	SRL (Klug et al., 2011; Zimmerman, 2002, 2013)
2	Assessing SRL	Considered different evidence-based methods for assessing students' SRL, namely Metacognitive Awareness Inventory, Motivated Strategies for Learning Questionnaire and different learning protocols.	MAI (Schraw & Dennison, 1994); MSLQ (Pintrich, Smith, Garcia, & McKeachie, 1993) Learning protocols (Berthold, Nückles, & Renkl, 2007; Eilam & Reiter, 2014; Nückles, Hübner, & Renkl, 2009)
3	SRL strategies	Considered key SRL strategies such as self-observation, self-talk and self-recording. Discussion about other learning strategies (e.g., cognitive, motivational, resource management)	SRL strategies (Pintrich, 1999; Reid, Lienemann, & Hagaman, 2013) Learning strategies (Askell-Williams et al., 2012; Donker, de Boer, Kostons, Dignath-van Ewijk, & van der Werf, 2014; Kiewra, 2002)
4	Explicit instruction of SRL strategies	Introduced middle-leaders to the notion of implicit and explicit strategy instruction.	Strategy instruction (Festas et al., 2015; González-Pienda, Fernández, Bernardo, Núñez, & Rosário, 2014; Kiewra, 2002; Kistner et al., 2015)
5	Debrief	Recapped aims of professional development program and involved activities for structured reflection and goal setting. Opportunity for middle-leaders to revisit previously generated questions about SRL and explicit teaching of SRL strategies. It allowed middle-leaders to engage in structured reflection, acknowledging growth and identifying future goals.	Reflective practice (Schön, 1987) SRL (Klug et al., 2011; Zimmerman, 2002, 2013)

Thinking-aloud and prompted lesson planning activity

In the final 30 minutes of the 2-hour professional education sessions (only sessions 1-4), middle-leaders recorded their thinking-aloud while completing a lesson planning activity that included metacognitive prompts for epistemic reflexivity (e.g., reflect on whether the planned teaching and learning activities align with school priorities/policies, refer Appendix K). According to Grossman (2008) scaffolding using reflective prompts can improve metacognition. Therefore, I argue that, theoretically, scaffolding using epistemic reflexive prompts developed using the DDD-D process of epistemic reflexivity framework (refer section 2.6.2) can improve epistemic reflexivity. The act of lesson planning represented what Ericsson and Simon (1980) referred to as a situation

"in which the verbalization is primary and must follow requirements of form and content imposed… by instructions" (p. 218). The 'instructions' were the metacognitive prompts for epistemic reflexivity about SRL that were intended to engage the middle-leaders in a deeper level of epistemic reflexivity about SRL beyond their regular lesson planning process. This form of prompted thinking-aloud was a 'generative process' (Ericsson & Simon, 1980, p. 219) as it required middle-leaders to provide "aspects of... [lesson planning] that a subject would not ordinarily verbalize or attend to", hence its potential to improve middle-leaders' epistemic reflexivity.

3.6.2. Enacted lesson plans, lesson observations and feedback

Following the professional education sessions, school middle-leaders enacted their lesson plans in their scheduled classes. I observed school middle-leaders' scheduled classes and documented teaching behaviours in a notebook using the 'diary description' method described by Montgomery (2012). This involved "making a running log of all that [was] seen" (p. 37) related to the explicit teaching of SRL strategies. The focus of lesson observations was guided by the categories listed in the ATES observation instrument (e.g., stimulating metacognitive reflection, activation of transfer, explicit instruction, implicit instruction, metacognitive strategies, cognitive strategies, motivation for strategy use)(Dignath-van Ewijk, Dickhäuser, & Büttner, 2013).

Following the lesson observation, I compiled my observational notes into an adapted version of the ladder of feedback - a feedback protocol designed by Perkins (2003). The ladder of feedback followed four stages of feedback (1) clarify, (2) value, (3) state concerns (deleted) and (4) suggest. Firstly, any questions that were raised for me from the lesson observation were listed in the 'clarify' category. Secondly, any observations that reflected effective teaching practice about SRL were acknowledged as valuable (i.e., 'value" category). Lastly, suggestions (i.e., 'suggest' category) were listed as how the school middle-leaders could improve their explicit teaching of SRL strategies. School middle-leaders were then provided the opportunity to receive feedback regarding their lesson observation as part of the PLC-ER about SRL. Lesson observation feedback provided school middle-leaders with an alternative perspective regarding their teaching practice about SRL. They were also able to ask questions regarding the feedback and gain clarity about their teaching approach, enabling them to develop a deeper understanding of the pedagogical strategies that underpin effective teaching for SRL. Situating teacher professional learning in their own classrooms, in the case of lesson observations, has been argued to be a highly effective professional development activity (Putnam & Borko, 2000). Table 3.7 documents the number of middle-leaders who took up the opportunity to receive lesson observation feedback and the mean time spent on lesson feedback.

Table 3.7. School middle-leaders who engaged in feedback and mean time spent

	After session 1	After session 2	After session 3	After session 4
No. of middle-leaders who engaged in feedback	**15**	**13**	**8**	**6**
Mean (minutes)	13:41	16:05	15:36	17:42
SD (minutes)	5:37	5:32	5:20	7:03
Max (minutes)	26:12	23:42	22:15	31:38
Min (minutes)	4:38	6:13	5:15	11:35

3.7. Data Collection

Data collection occurred with the primary aim of assessing the emergent changes (i.e., direct, flow-on, proximal and distal effects) of the middle-leaders' PLC-ER about SRL. This section outlines the data collection methods chosen. Figure 3.2 provides a visual overview of the proximity of participant groups to the school middle-leaders' PLC-ER about SRL.

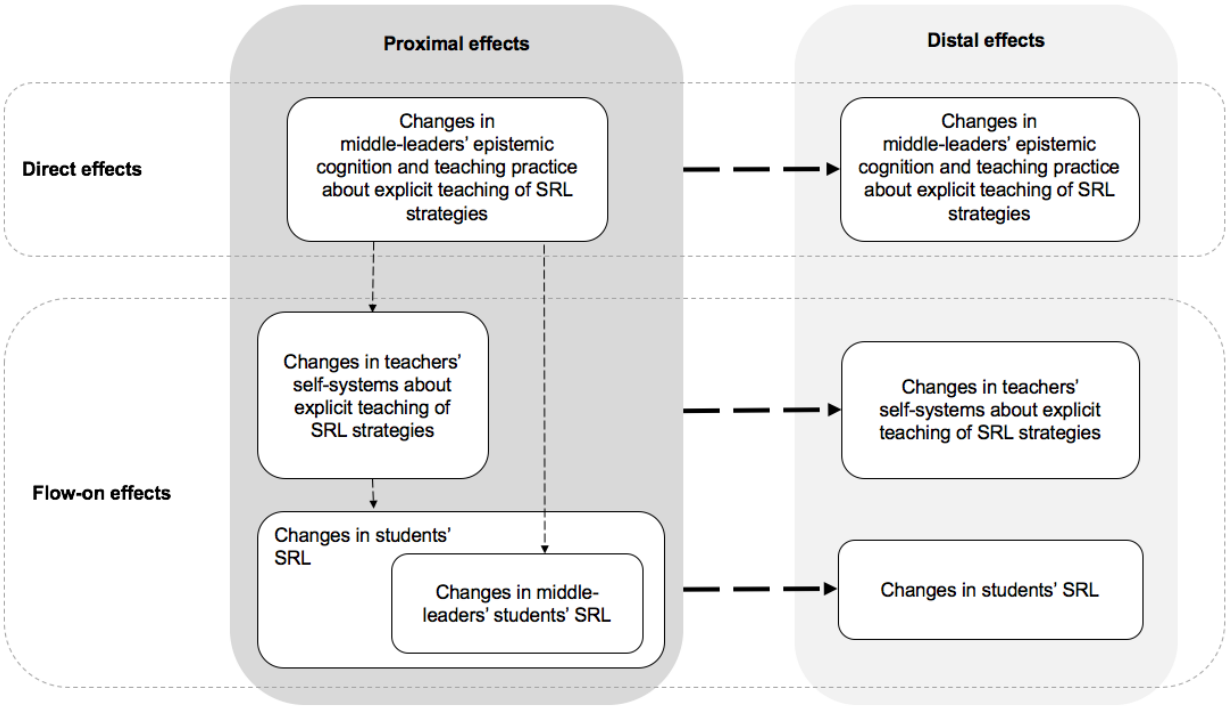

Figure 3.2. Visual overview of direct, flow-on, proximal and distal effects of PLC-ER about SRL

3.7.1. Moving beyond self-report measures

Typically, in the field of epistemic beliefs, or more recently under the umbrella of epistemic cognition, researchers have typically used self-report measures such as surveys to investigate such beliefs about knowledge (for example, Greene & Yu, 2014; Schommer, 1990). This has also

been the case in studies that have explored teachers' thinking and practice about SRL (Dignath-van Ewijk, 2016; Heirweg et al., 2020; Karlen, Hertel, & Nadja, 2020; Thomas et al., 2020). There are numerous limitations to self-report measures. For example, participants might engage in *selective recall* (offering limited information of choice), or *satisficing* explained as "to settle for a 'good enough' answer" (Hamby & Taylor, 2016, p. 913) thus reducing the reliability and validity of data collected. Due to these limitations, Chinn and Rinehart (2016) advocated that researchers move beyond "generalised self-reported beliefs" (p. 472) to consider how, in practice, epistemic cognition plays out. More recently, researchers have advocated for measures that move beyond self-report measures (Barnes et al., 2020; Karlen et al., 2020). Responding to these recommendations, I selected a range of data collections methods, including self-report measures, but not solely dependent on self-report measures. To measure direct effects of the PLC-ER about SRL, data about school middle-leaders' epistemic cognition and teaching practice about explicit teaching of SRL strategies were collected using three instruments; the Teacher Epistemic Cognition about SRL (TEC-SRL) questionnaire, the audio-recorded thinking-aloud activities (Ericsson & Simon, 1980), completed lesson planning template, and video-recorded lesson observations. To measure flow-on effects of the PLC-ER about SRL, data about regular classroom teachers' beliefs for teaching about SRL, students' SRL behaviours and the school's decision points were collected using four instruments: a modified version of the TEC-SRL questionnaire, a student SRL Process Protocol, a student questionnaire about SRL (i.e., Metacognitive Awareness Inventory) and the researcher's field notes. To measure proximal effects, data were collected immediately following the PLC-ER about SRL. To measure distal effects, data were collected 9-months following the conclusion of the PLC-ER about SRL.

Table 3.8 reports details of the participant groups and completed data collection methods. In the table, an asterisk ('*') indicates a shortened version of the TEC-SRL and a check mark (✓) indicates a completed data collection method.

Table 3.8. Participant groups and completed data collection methods

	Participant group			
Data collection method	**Middle-leaders**	**Teachers**	**Middle-leaders' students**	**Teachers' students**
Before the PLC-ER about SRL (Week 0)				
TEC-SRL questionnaire	✓	✓		
Think-aloud and lesson plan	✓			
Video-recorded lesson observation	✓			
SRL Process Protocols			✓	✓

Metacognitive Awareness Inventory					✓
During the PLC-ER about SRL (Weeks 1-11)					
Think-aloud and lesson plan x4	✓				
Video-recorded lesson observation x4	✓				
SRL Process Protocols				✓	
After the PLC-ER about SRL (Week 12)					
TEC-SRL questionnaire	✓	✓			
Think-aloud and lesson plan	✓				
Video-recorded lesson observation	✓				
SRL Process Protocols				✓	✓
Metacognitive Awareness Inventory					✓
Nine months after the PLC-ER about SRL (Week 52)					
TEC-SRL questionnaire	✓	✓			
Think-aloud and lesson plan	✓				
Video-recorded lesson observation	✓				
SRL Process Protocols				✓	✓
Metacognitive Awareness Inventory					✓

3.7.2. Developing, testing and refining the TEC-SRL questionnaire

My evaluation of the literature about epistemic cognition found no suitable questionnaire that comprehensively addressed the scope of epistemic cognition in the present study. Extant literature highlighted questionnaires or items related to epistemic cognition (for example, Fives & Buehl, 2008; Greene & Yu, 2014); however, these failed to target teachers' epistemic cognition about the explicit teaching of SRL strategies. Accordingly, I constructed a Teacher Epistemic Cognition about Self-Regulated Learning (TEC-SRL) questionnaire.

Initial construction of the TEC-SRL questionnaire

The TEC-SRL questionnaire began with an introductory paragraph about the study's objectives and instructions for how to respond to the different question types. Question items were selected and adapted from a range of research studies or created based on theoretical foundations.

All question items underwent several rounds of refinement between researcher and an expert in the field. Iarossi (2006) advised that consulting previous literature and speaking with experts in the field of interest was a necessary step to identifying which questions would best elicit the desired information. Warwick and Lininger (1975) provided further support, arguing that engaging

with field experts around questionnaire design increased the alignment between hypotheses, item wording and audience accessibility.

Open-ended question items included a short-form text box (limited characters) to encourage participants to consider their responses and provide clear and concise answers. Closed-ended question items followed a Likert-scale questionnaire design as it offered a level of convenience for participation and researcher analysis (Neuman, 2006). A seven-point Likert scale was selected to enable differentiation, on the basis that "too few steps (i.e., Likert scale points) loses differentiating information because people who use the same response category may differ if intermediate steps were included" (Bandura, 2006, p. 312). I selected response anchors of Very Untrue (1), Untrue (2), Somewhat Untrue (3), Neutral (4), Somewhat True (5), True (6) and Very True (7) as the notion of 'true' lends itself well to epistemic cognition and the beliefs that a teacher holds as true or untrue. Additionally, these response anchors are similar to those of the teacher questionnaire used by Dignath-van Ewijk (2016) in their investigations of teachers' thinking about SRL, with only slight differences in anchor names (e.g., 'not true at all' to 'completely true').

Wording of question items were also considered carefully. Lietz (2010) argued that responding to a questionnaire "involves a judgment… that is related to the respondent's motivation and preparedness to be truthful" (p. 249). To ascertain a genuine picture of teachers' epistemic cognition about the explicit teaching of SRL strategies, attaining honest participant responses was of critical importance, so question items were worded using clear and concise language to encourage (e.g., It is important to assess students' knowledge about SRL).

Demographic questions were placed at the end of the questionnaire as they were deemed straightforward and easy to answer (Hughes, Camden, & Yangchen, 2016), ensuring participant interest and attention were maximised for the question items related to epistemic cognition. Additionally, the TEC-SRL questionnaire included a statement of gratitude to acknowledge participant completion. The final version of the questions can be seen in Table 3.10.

Following construction of the TEC-SRL questionnaire (39 question items), testing and refinement occurred.

Pilot testing of the TEC-SRL questionnaire

Pilot testing is considered a critical component of questionnaire design and quality by numerous researchers (for example, Iarossi, 2006; Mertens, 2010). It allows for an evaluation of the appropriateness of each item (Cleary, 2006). Drawing on extant literature, Connelly (2008) suggested that "a pilot study sample be 10% of the sample projected for the larger parent study" (p. 411). Ten percent of the available middle-leader pool (n=19) is approximately two middle-leaders. Ten percent of the available regular classroom teacher participant pool (n=110) is

11 regular classroom teachers. Taking these differences into consideration, the pilot sample comprised 3 middle-leaders and 3 regular classroom teachers, a pilot sample size of 6 (the median of the range 2-11).

Middle-leaders were required to complete the whole TEC-SRL questionnaire, while regular classroom teachers were only required to complete a modified version of the TEC-SRL questionnaire. Table 3.9 reports the demographic information of the pilot sample.

Table 3.9. Pilot sample demographic information

Pilot	Gender	Role	School	Experience (years)	Highest qualification	PD in SRL or similar
1	M	Classroom teacher	Public	6-10	Bachelor's	Yes (Learning Strategies, Special Education)
2	F	Middle-leader	Public	11+	Bachelor's	Yes (Special Education
3	M	Classroom teacher	Catholic	6-10	Bachelor's	Yes (Learning Strategies)
4	F	Middle-leader	Catholic	6-10	Bachelor's	Yes (Learning Strategies, Special Education)
5	F	Classroom teacher	Independent	11+	Bachelor's	Yes (Learning Strategies, Special Education)
6	M	Middle-leader	Independent	6-10	Master's	Yes (Learning Strategies)

All teachers were secondary teachers and were in the age range 30-39. Their schools represented the three main schooling systems (Public, Catholic, Independent) available in Victoria, Australia.

Teachers in the pilot sample were not part of the main study, nor were they from the school which participated in the main study.

Pilot questionnaire respondents were asked to consider each question item carefully and provide feedback related to the question clarity, wording and overall structure of question items. Feedback was sent to the researcher via email, and in some cases a follow up phone-conversation occurred between researcher and pilot participant.

Refining the TEC-SRL questionnaire

Following pilot testing, each questionnaire item was reviewed by the researcher and necessary modifications were made which involved rewording or editing structural and format elements of the questionnaire. For example, four of the five participants in the pilot study fed back to the researcher that they either had to look up the term SRL or guess what it was, highlighting a lack of knowledge about SRL and the absence of a shared definition about SRL. Pilot questionnaire respondents worked at schools beyond the school of focus, so level of their exposure to the concept of SRL was unknown. A lack of knowledge of a definition of SRL could cause issues for

participant responses as ‘SRL’ was included in many of the TEC-SRL question items (e.g., What is the best way to assess students’ SRL? In the past week, how many lessons have you assessed students’ SRL in this way?). The inclusion of a definition of SRL in the questionnaire was considered. However, acknowledging the potentially leading influence of including such a definition on participants’ responses, the decision was made not to include a definition. Furthermore, in the present study this lack of familiarity with the term SRL was deemed to be unlikely as conversations with the Deputy Principal (delegate of the Principal) prior to research engagement indicated previous use of the term SRL. To ensure and assess level of knowledge and understanding of SRL, the first open-ended questionnaire item asked participants to define SRL. This matter of understanding the concept of SRL should be considered for future research using the TEC-SRL questionnaire.

Of the initial 31 items, seven were reworded or replaced in response to feedback received from the pilot testing phase. For example, the term ‘epistemic’ was unknown across all five pilot participants. For ease of understanding, the term epistemic was replaced with more accessible language. For instance, ‘Epistemic Aims about SRL’ was replaced with ‘Teaching Goals about SRL’. The title of the questionnaire ‘Teachers’ Epistemic Cognition about SRL’ was replaced with ‘Teachers’ Knowledge and Beliefs about Self-Regulated Learning’.

Feedback related to the questionnaire format was also considered. Response boxes were increased from short-form text boxes (limited characters) to long-form text boxes (unlimited characters) to attain as much information as possible from the participant. Font size was reduced from 14 point to 12 point for ease of reading and to improve the overall aesthetics of the survey. Due to limitations of the survey platform, some feedback was unable to be acted on (e.g., changing layout of question text boxes so that questions did not have split words).

3.7.3. Completing and distributing the TEC-SRL questionnaire

Following testing and refinement, the final set of 47 questionnaire items formed the TEC-SRL questionnaire used in the present study. Table 3.10 provides question (item), origin (supporting research), type and theoretical foundations (measured construct).

Table 3.10. Question items, supporting research, question type and measured construct

Item	Supporting research	Type	Measured construct
1. According to you: What is Self-Regulated Learning (SRL)? Please provide as much detail as possible.	Fives and Buehl (2008, p. 173) - “What is teaching?”	Open	Content knowledge

Item	Supporting research	Type	Measured construct
2. What are the 'types' of things your students need to know to self-regulate their learning well?	Knowledge about SRL - (Askell-Williams, Barr, & Ngendahayo, 2019; Askell-Williams et al., 2012)	Open	Content knowledge
3. What knowledge is necessary for effective teaching about SRL? Please be specific.	Fives and Buehl (2008, p. 173) - "What knowledge is necessary for effective teaching? Please be specific."	Open	Pedagogical knowledge
4. Knowledge of how to self-regulate learning comes from the teacher	Fives and Buehl (2008, p. 173) - "Where does knowledge of how to teach come from?"	Likert scale (1 = not true; 7 = very true)	Epistemic belief about the source of SRL knowledge
5. Knowledge of how to self-regulate learning comes from a student's own personal construction	Fives and Buehl (2008, p. 173) - "Where does knowledge of how to teach come from?"	Likert scale (1 = not true; 7 = very true)	Epistemic belief about the source of SRL knowledge
6. SRL is a talent students are born with	Fives and Buehl (2008, p. 173) - "Is teaching a talent people are born with? Please explain." Schommer Epistemological Questionnaire (Duell & Schommer-Aikins, 2001) – "Some people are born good learners, others are just stuck with limited ability"	Likert scale (1 = not true; 7 = very true)	Epistemic belief about SRL knowledge as innate ability
7. Students can learn how to be effective self-regulated learners	Fives and Buehl (2008, p. 173) - "Can someone learn how to be an effective teacher? Please explain."	Likert scale (1 = not true; 7 = very true)	Epistemic belief about SRL knowledge as innate ability
8. Knowledge of SRL is equal in complexity to other subjects (e.g., maths)	Dimensions of quality in teacher knowledge (Lawson et al., 2009)	Likert scale (1 = not true; 7 = very true)	Epistemic belief about the structure of SRL knowledge
9. When planning a regular lesson, I explicitly set a teaching goal to develop students' knowledge about SRL	Epistemic aims and epistemic value (Chinn et al., 2014; Fives et al., 2017)	Likert scale (1 = not true; 7 = very true)	Epistemic value
10. It is important to develop students' knowledge about SRL	SRL microanalysis measure (Peters-Burton & Botov, 2017) Peters-Burton and Botov (2017, p. 55) - "How important is planning an inquiry lesson in attaining your future goals?"	Likert scale (1 = not true; 7 = very true)	Epistemic value
11. When planning a regular lesson, I explicitly set a teaching goal to assess students' knowledge about SRL	Peters-Burton and Botov (2017, p. 55) - "Do you have a goal to help your process of planning an inquiry lesson? If so, what is it?"	Likert scale (1 = not true; 7 = very true)	Epistemic value

Item	Supporting research	Type	Measured construct
12. It is important to assess students' knowledge about SRL	SRL microanalysis measure (Peters-Burton & Botov, 2017) Peters-Burton and Botov (2017, p. 55) - "How important is planning an inquiry lesson in attaining your future goals?"	Likert scale (1 = not true; 7 = very true)	Self-Reported Practice/Epistemic value
For the following two items, please indicate percentage of total number of lessons taught 13. In the past week, how many lessons have you explicitly set a teaching goal to develop students' knowledge about SRL?	Peters-Burton and Botov (2017, p. 55) - "Do you have a goal to help your process of planning an inquiry lesson? If so, what is it?"	Likert scale (1 = 0-15%; 7 = >90%) percentage of total number of lessons taught	Self-Reported Practice/Epistemic aims
14. In the past week, how many lessons have you explicitly set a teaching goal to assess students' knowledge about SRL	Self-reported practice (with a focus on epistemic aims) (Chinn et al., 2014)	Likert scale (1 = 0-15%; 7 = >90%)	Epistemic aims
15. I know when students have achieved deeper knowledge about SRL	Epistemic ideals (Chinn et al., 2014; Fives et al., 2017)	Likert scale (1 = not true; 7 = very true)	Epistemic ideals about SRL
16. How do you know if students have achieved deeper knowledge about SRL?	Epistemic ideals (Chinn et al., 2014; Fives et al., 2017)	Open	Epistemic ideals about SRL
17. I use a set of criteria to evaluate whether students have achieved deeper knowledge about SRL	Epistemic ideals (Chinn et al., 2014; Fives et al., 2017)	Likert scale (1 = not true; 7 = very true)	Epistemic ideals about SRL
18. If so, what criteria do you use?	Epistemic ideals (Chinn et al., 2014; Fives et al., 2017)	Open	Epistemic ideals about SRL
19. I pace myself while I am teaching about SRL in order to have enough time.	Metacognitive Awareness Inventory (MAI) and Metacognitive Awareness Inventory for Teachers (MAIT) (Balcikanli, 2011; Schraw & Dennison, 1994)	Likert scale (1 = not true; 7 = very true)	Metacognitive regulation of teaching about SRL
20. I ask myself periodically if I meet my teaching goals about SRL while I am teaching.	Metacognitive Awareness Inventory (MAI) and Metacognitive Awareness Inventory for Teachers (MAIT) (Balcikanli, 2011; Schraw & Dennison, 1994)	Likert scale (1 = not true; 7 = very true)	Metacognitive regulation of teaching about SRL
21. I ask myself how well I have accomplished my teaching goals about SRL once I am finished	Metacognitive Awareness Inventory (MAI) and Metacognitive Awareness Inventory for Teachers (MAIT)	Likert scale (1 = not true; 7 = very true)	Metacognitive regulation of teaching about SRL

Item	Supporting research	Type	Measured construct
	(Balcikanli, 2011; Schraw & Dennison, 1994)		
22. I set my specific teaching goals about SRL before I start teaching	Metacognitive Awareness Inventory (MAI) and Metacognitive Awareness Inventory for Teachers (MAIT) (Balcikanli, 2011; Schraw & Dennison, 1994)	Likert scale (1 = not true; 7 = very true)	Metacognitive regulation of teaching about SRL
23. I find myself assessing how useful my teaching techniques for SRL are while I am teaching.	Metacognitive Awareness Inventory (MAI) and Metacognitive Awareness Inventory for Teachers (MAIT) (Balcikanli, 2011; Schraw & Dennison, 1994)	Likert scale (1 = not true; 7 = very true)	Metacognitive regulation of teaching about SRL
24. I ask myself if I could have used different SRL techniques after each teaching experience.	Metacognitive Awareness Inventory (MAI) and Metacognitive Awareness Inventory for Teachers (MAIT) (Balcikanli, 2011; Schraw & Dennison, 1994)	Likert scale (1 = not true; 7 = very true)	Metacognitive regulation of teaching about SRL
25. I ask myself questions about SRL teaching materials I am going to use.	Metacognitive Awareness Inventory (MAI) and Metacognitive Awareness Inventory for Teachers (MAIT) (Balcikanli, 2011; Schraw & Dennison, 1994)	Likert scale (1 = not true; 7 = very true)	Metacognitive regulation of teaching about SRL
26. I check regularly to what extent my students comprehend the topic of SRL while I am teaching.	Metacognitive Awareness Inventory (MAI) and Metacognitive Awareness Inventory for Teachers (MAIT) (Balcikanli, 2011; Schraw & Dennison, 1994)	Likert scale (1 = not true; 7 = very true)	Metacognitive regulation of teaching about SRL
27. After teaching a point about SRL. I ask myself if I'd teach it more effectively next time.	Metacognitive Awareness Inventory (MAI) and Metacognitive Awareness Inventory for Teachers (MAIT) (Balcikanli, 2011; Schraw & Dennison, 1994)	Likert scale (1 = not true; 7 = very true)	Metacognitive regulation of teaching about SRL
28. I organise my time to best accomplish my teaching goals about SRL.	Metacognitive Awareness Inventory (MAI) and Metacognitive Awareness Inventory for Teachers (MAIT) (Balcikanli, 2011; Schraw & Dennison, 1994)	Likert scale (1 = not true; 7 = very true)	Metacognitive regulation of teaching about SRL
29. I ask myself questions about how well I am doing while I am teaching about SRL.	Metacognitive Awareness Inventory (MAI) and Metacognitive Awareness Inventory for Teachers (MAIT)	Likert scale (1 = not true; 7 = very true)	Metacognitive regulation of teaching about SRL

Item	Supporting research	Type	Measured construct
	(Balcikanli, 2011; Schraw & Dennison, 1994)		
30. I ask myself if I have considered all possible SRL techniques after teaching a point.	Metacognitive Awareness Inventory (MAI) and Metacognitive Awareness Inventory for Teachers (MAIT) (Balcikanli, 2011; Schraw & Dennison, 1994)	Likert scale (1 = not true; 7 = very true)	Metacognitive regulation of teaching about SRL
31. What is the best way to teach students SRL? Why?	Dignath-van Ewijk and van der Werf (2012) based on Lonka, Joram, and Bryson (1996)	Open	Knowledge
For the following two items, please indicate percentage of total number of lessons taught 32. In the past week, how many lessons have you taught students' SRL in this way?	Measure of explicit teaching of SRL strategies (Dignath-van Ewijk et al., 2013)	Likert scale (1 = 0-15%; 7 = >90%) percentage of total number of lessons taught	Self-reported practice
Explicitly teaching students about SRL strategies can improve student SRL knowledge 33. In the past week, how many lessons have you taught students' SRL in this way?	Measure of explicit teaching of SRL strategies (Dignath-van Ewijk et al., 2013)	Likert scale (1 = 0-15%; 7 = >90%)	Self-reported practice
34. What is the best way to assess students' SRL? Why?	Dignath-van Ewijk and van der Werf (2012) based on Lonka et al. (1996)	Open	Knowledge
For the following two items, please indicate percentage of total number of lessons taught 35. In the past week, how many lessons have you assessed students' SRL in this way?	Measure of explicit teaching of SRL strategies (Dignath-van Ewijk et al., 2013)	Likert scale (1 = 0-15%; 7 = >90%) percentage of total number of lessons taught	Self-reported practice
Metacognitive prompts (e.g., what is your goal for this task?) can engage students in SRL and provide valuable feedback on how students are self-regulating their learning. 36. In the past week, how many lessons have you incorporated	Measure of explicit teaching of SRL strategies (Dignath-van Ewijk et al., 2013)	Likert scale (1 = 0-15%; 7 = >90%)	Self-reported practice

Item	Supporting research	Type	Measured construct
metacognitive prompts in your teaching?			
37. Leadership staff in my school support explicit teaching of SRL	Assessment of Barriers to Implementation and Sustainability in Schools ABISS (Turri et al., 2016)	Likert scale (1 = not true; 7 = very true)	Perceptions of enablers and barriers
38. I have undertaken useful professional development about SRL	Assessment of Barriers to Implementation and Sustainability in Schools ABISS (Turri et al., 2016)	Likert scale (1 = not true; 7 = very true)	Perceptions of enablers and barriers
39. Many staff in my school have undertaken useful professional development about SRL	Assessment of Barriers to Implementation and Sustainability in Schools ABISS (Turri et al., 2016)	Likert scale (1 = not true; 7 = very true)	Perceptions of enablers and barriers
40. My school regularly reports to staff our progress with developing students' SRL	Assessment of Barriers to Implementation and Sustainability in Schools ABISS (Turri et al., 2016) This relates to Fullan's (2006) element "dual commitment to short-term and long-term results" (p. 120). Fullan argued that "shorter-term results are also necessary to build trust with the public or shareholders for longer-term investments" (p. 120)	Likert scale (1 = not true; 7 = very true)	Perceptions of enablers and barriers
41. Promoting students' SRL is included in our school mission statements	Assessment of Barriers to Implementation and Sustainability in Schools ABISS (Turri et al., 2016)	Likert scale (1 = not true; 7 = very true)	Perceptions of enablers and barriers
42. Our parent community supports us teaching about SRL	Assessment of Barriers to Implementation and Sustainability in Schools ABISS (Turri et al., 2016)	Likert scale (1 = not true; 7 = very true)	Perceptions of enablers and barriers
43. In my school, developing students' knowledge about SRL forms part of the curriculum	Assessment of Barriers to Implementation and Sustainability in Schools ABISS (Turri et al., 2016)	Likert scale (1 = not true; 7 = very true)	Perceptions of enablers and barriers
44. If the key staff who promote SRL were to leave our school the emphasis on it would probably die out	Assessment of Barriers to Implementation and Sustainability in Schools ABISS (Turri et al., 2016)	Likert scale (1 = not true; 7 = very true)	Perceptions of enablers and barriers
45. In truth, SRL is a current fad, that will eventually be replaced by the next 'big thing'	Assessment of Barriers to Implementation and Sustainability in Schools ABISS (Turri et al., 2016)	Likert scale (1 = not true; 7 = very true)	Perceptions of enablers and barriers

Item	Supporting research	Type	Measured construct
	"[System thinking] keeps [the other four disciplines] from being separate gimmicks or the latest organization fads" (Senge, 1990, pp. 12-13)		
46. What is the most important factor for sustained implementation of explicit teaching of SRL? Please explain.	SUBSIST (McIntosh et al., 2009) two open-ended items (Pinkelman, McIntosh, Rasplica, Berg, & Strickland-Cohen, 2015) School-Wide Universal Behaviour Sustainability Index-School Teams (SUBSIST)(McIntosh et al., 2011)	Open	Perceptions of enablers and barriers
47. What is the most significant barrier to sustaining explicit teaching of SRL? Please explain.	SUBSIST (McIntosh et al., 2009) two open-ended items (Pinkelman et al., 2015) School-Wide Universal Behaviour Sustainability Index-School Teams (SUBSIST)(McIntosh et al., 2011)	Open	Perceptions of enablers and barriers

Distributing the TEC-SRL questionnaire

The questionnaire was delivered online using the Australian Consortium for Social and Political Research Incorporated (ACSPRI) CANVASS Web Survey Service.

I chose this platform as it is hosted in Australia, securely transmits data and its overall functionality met the needs of the present study and was ethics sound (as per ethics approval granted for this study). The online delivery was advantageous as all participant responses were automatically entered into an excel spreadsheet. Therefore, no manual data entry was necessary, reducing chances of data entry errors. Additionally, as the target sample of middle-leaders and regular classroom teachers were English-speaking, only an English version of the TEC-SRL questionnaire was created and no translation was needed. The TEC-SRL questionnaire is included as Appendix I.

3.7.4. Validity and reliability of the TEC-SRL questionnaire

To address validity and reliability of the TEC-SRL questionnaire, several methods were adopted. Construct validity is defined as "the degree to which individual [question] items represent the construct being measured, and cover the full range of the construct" (Field, 2018, p. 15). Construct validity has also been argued by Bannigan and Watson (2009) as "the minimum requirement of acceptance of a scale" (p. 3240) and is present when a questionnaire has a sound theoretical base. Construct validity was achieved by first clearly conceptualising teachers' epistemic cognition

prior to questionnaire design, and then drawing on questions already validated by other researchers in the field of epistemic cognition and SRL. Likewise, it was attained via reviews between the researcher and a recognised expert in the field as well as the abovementioned pilot testing and resultant modifications. Additionally, as the questionnaire was completed in an online written format, responses were descriptively accurate and valid. There was no chance to "mis-hear, mis-transcribe, or mis-remember… [participants'] words" (Huberman & Miles, 2002, p. 46).

As the TEC-SRL questionnaire was semi-structured and conducted with a small sample (N = 16), statistical procedures for reliability (i.e., internal consistency) such as the calculation of Cronbach's alpha were not applied. According to Field (2018), sample sizes smaller than 100 should not have correlation coefficients calculated due to potential fluctuation between samples.

3.7.5. Thinking aloud while lesson planning

There is consensus in the field of epistemic cognition (e.g., Barnes et al., 2020; Fives et al., 2017; Greene & Yu, 2014), that future studies complement questionnaires with process measures, such as audio-recorded thinking-aloud. Responding to this recommendation, a think-aloud protocol formed a critical component of the present study, and was used to capture middle-leaders' epistemic cognition for teaching while they engaged in a *regular* or *reflexive* lesson planning activity. A 'think-aloud' is a "concurrent verbal report… [that] typically involves individual assessment in which participants are instructed to verbalise their thoughts, feelings, and cognitive processes while performing a task" (Vandevelde et al., 2015, p. 13). Audio-recording a person's thinking aloud acts as a measure of real-time internal processes and have been shown to gather useful information related to epistemic beliefs, activation of prior knowledge and epistemic cognition (Barzilai, 2017; Mason, Boldrin, & Ariasi, 2010). Therefore, verbal data produced as part of a think-aloud has potential to be used as the basis to infer the internal process of epistemic cognition. It is as Barnes et al. (2020) stated:

> Because think-aloud methods allow for externalization of teachers' internal dialogue, they allow researchers to capture the practices and processes teachers use when they engage in epistemic cognition. As a result, researchers can glean insight into how teachers justify claims, weigh sources of information, evaluate their own and their students' claims, and reason about their knowledge, and their students' knowledge (Barnes et al., 2020, p. 4).

Ericsson and Simon (1993) identified two key limitations associated with thinking-aloud. First, they postulated that the act of thinking-aloud can change how an individual performs a task, such as how a teacher engages in lesson planning about SRL. The problem of potential 'change' has been mitigated in the present study by inviting school middle-leader participants to audio record their thinking-aloud at every stage of data collection of the present study (i.e., before, during,

immediately after and nine months after the PLC-ER intervention). The second objection raised by Ericsson and Simon was that “the processes underlying behaviour may be unconscious and thus not accessible for verbal reporting, or at least may be reportable only very incompletely” (p. 169). To address this challenge and to encourage school middle-leaders thinking-aloud, they were carefully trained in the think-aloud protocol.

Think-aloud protocol training

Prior to commencement of the PLC-ER intervention, school middle-leaders attended a 45-minute training session about how to perform a think-aloud while engaging in regular lesson planning. First, the school middle-leader participant group were provided a single-page of written instructions describing the think-aloud protocol (Appendix N) and a lesson plan template consisting of regular lesson planning prompts (e.g., learning outcomes, main activities, refer to Appendix J). Both documents were accompanied by a verbal explanation by the researcher. School middle-leaders were encouraged to ask questions throughout the training for clarity and understanding. No questions were asked. After explaining the written instructions, I asked for a volunteer to help model the process of thinking aloud while lesson planning. One school middle-leader agreed to model their thinking aloud having completed one in the past. Following the demonstration, participants were given time to find a quiet space and record at least two attempts at thinking-aloud while planning a regular lesson using the lesson planning template as practice.

When thinking aloud while lesson planning, school middle-leaders were engaged in a dual task, that is they had to “perform the task [i.e., lesson planning]… and produce the verbalizations [i.e., thinking-aloud]” (Ericsson & Simon, 1980, p. 218). In terms of information processing, dual tasks can create extraneous cognitive load that interferes with the task itself or the verbalization. This is further supported by Charters (2003) who claimed that the cognitive load associated with dual tasks could inhibit an individual’s ability to articulate their thoughts clearly. All school middle-leader participants reported having six or more years of teaching experience (refer Table 3.2) and were using their own lesson planning as the context, so the cognitive effort required in thinking aloud while engaged in regular lesson planning was expected to be minimal. Surprisingly, after the school middle-leader participants recorded two attempts at thinking-aloud for practice, they expressed difficulty with thinking-aloud while hand-writing or typing their lesson plans. One school middle-leader shared that as he has been teaching his subject for numerous years, he mostly recorded brief notes in his teacher chronicle (e.g., ‘blank’ worksheet, ‘blank’ activity) or planned his lesson on his walk to the scheduled class. Other school middle-leaders indicated they shared this same habit (of not creating written lesson plans), typically because of their current workloads and available time. To acknowledge the challenges expressed by school middle-leaders

and not compromise the quality of their thinking-aloud, school middle-leaders were instructed to prioritise completion of the audio-recorded think-aloud over the hand-written/typed lesson plan.

Collection of audio-recorded thinking-aloud and lesson plans

Before, during, and after the PLC-ER about SRL, each school middle-leader audio-recorded their think-aloud protocol while planning a lesson of their choice and using either the *regular* lesson plan template (refer Appendix J) or the *reflexive* lesson plan template (refer Appendix K). To minimise demand characteristics before and after the PLC-ER about SRL data collection measures, middle-leaders were reminded that the lesson plans were to reflect a 'regular' lesson and should be prepared as such. Hand-written or typed lesson plans were collected.

The number of submitted lesson plans for each data collection point are reported in Table 3.11. In the table, the columns before PLC-ER about SRL at *Week 0*, immediately after PLC-ER about SRL at *Week 12* and 9 months after PLC-ER about SRL at *Week 52* involved *regular* lesson planning activity. The columns under *During PLC-ER about SRL* involve *reflexive* lesson planning activity.

Table 3.11. Submitted lesson plan documents

	Week 0	During PLC-ER about SRL				Week 12	Week 52
		After session 1	After session 2	After session 3	After session 4		
Submitted lesson plans	1	10	6	8	6	6	2

Due to difficulties expressed by middle-leaders regarding completing the dual task of thinking aloud and writing the lesson plan, the number of submitted written/typed lesson plans varied substantially depending on the middle-leader.

Each middle-leader's thinking-aloud was audio-recorded personally by the individual middle-leader using their own chosen recording device (e.g., laptop, mobile phone). Model and make of recording devices varied depending on the preference of the middle-leader.

Numbers of think-aloud audio-recordings at each data collection point along with mean, standard deviation, maximum and minimum values are reported in Table 3.12. In the table, the columns before PLC-ER about SRL at *Week 0*, immediately after PLC-ER about SRL at *Week 12* and 9 months after PLC-ER about SRL at *Week 52* involved *regular* lesson planning activity. The columns under *During PLC-ER about SRL* involve *reflexive* lesson planning activity.

Table 3.12. Submitted think-aloud audio-recordings

	Week 0	During PLC-ER about SRL				Week 12	Week 52
		After session 1	After session 2	After session 3	After session 4		
Submitted think-aloud audio-recordings	12	11	8	8	6	7	6
Mean (minutes)	5:55	4:48	4:58	5:17	3:32	4:52	4:66
SD (minutes)	2:17	3:09	2:53	2:07	2:11	1:25	1.20
Max (minutes)	8:46	11:37	11:56	9:14	7:36	7:40	6.40
Min (minutes)	2:17	1:24	2:11	2:47	1:23	3:16	2.54

Prior to the PLC-ER about SRL, middle-leaders spent, on average, 5:55 minutes thinking aloud (SD 2:17; Maximum 8:46; Minimum 2:17) while engaged in a *regular* lesson planning activity. The range of 2:17 minutes to 7:51 minutes is substantial but both times reflect the middle-leaders' process of lesson planning. During the PLC-ER about SRL, the middle-leaders spent, on average, 4:38 minutes thinking aloud (SD 2:45; Maximum 11:56; Minimum 1:23) while engaged in the *reflexive* lesson planning activity. Immediately after the PLC-ER intervention, the middle-leaders spent, on average, 4.88 minutes thinking aloud (SD 1.41; Maximum 7.4; Minimum 3.16) while engaged in a *regular* lesson planning activity. Nine months following completion of the PLC-ER about SRL, the middle-leaders spent, on average, 4:66 minutes thinking aloud (SD 1.20; Maximum 6.40; Minimum 2.54) while engaged in a *regular* lesson planning activity.

Audio files were transferred from the middle-leaders' recording device via USB, SD memory card or electronic means (e.g., email, drop-box) to the researcher's Apple Macbook Air (2014). Think-aloud audio-recordings were first transcribed using the automated NVivo transcription service. Following this initial transcription, the researcher listened to each audio recording and cross-checked the audio against each transcription for accuracy. When the transcription did not match the audio recording, the necessary changes were made to reflect the original. There were 748 transcription errors (e.g., incorrect word), representing 6.35 per cent of all transcribed data. Each transcription was then exported from the NVivo transcription service to NVivo for Mac (Version 11.4.3) for coding.

3.7.6. Video-recorded lessons

Lesson observations conducted during the PLC-ER about SRL were video-recorded as part of data collection [i.e., a SONY Digital HD Video Camera Recorder (Model No: HDR-PJ10E) and matching tripod were set up at the back or side of the classroom]. Researchers (Barnes et al., 2020; Chinn & Rinehart, 2016) have advocated for measures that move beyond questionnaires to include process measures such as think-aloud protocols and video-recorded lesson observations. Vosniadou et al. (2020) encouraged that "future research needs to investigate in greater detail and through in-depth-interviews and observations whether and how … practicing teachers reconcile their opposing beliefs about [SRL]…, what misconceptions they might form, and how they influence their practices" (p. 15). It is as Dignath-van Ewijk et al. (2013) stated "[observations] have the advantage of assessing *behaviour*, not just the opinion of someone" (p. 341). This supports what Argyris and Schön (1974) argued - that individuals (e.g., teachers) possess different theories that underpin what they say (i.e., espoused theories) and what they do (i.e., theories-in-use). In the present study, lesson observations allowed for analysis of middle-leaders' theories-in-action. Furthermore, classroom observations enable a researcher to investigate processes such as epistemic cognition in an authentic and naturalistic context.

Each school middle-leaders' planned lesson was video-recorded in their scheduled classroom before, during, immediately after and nine months after the PLC-ER about SRL. A SONY Digital HD Video Camera Recorder (Model No: HDR-PJ10E) and matching tripod were set up at the back or side of the classroom to reduce disruption to class activities and potential Hawthorne effect. To minimise any demand characteristics before, immediately after and 9 months after the PLC-ER about SRL, middle-leaders were reminded that they should follow their lesson plan as per a 'regular' lesson.

Mean, standard deviation, maximum and minimum values for school middle-leaders' video-recorded lessons are reported in Table 3.13. In the table, the columns *Before PLC-ER about SRL at Week 0*, *Immediately after PLC-ER* about *SRL at Week 12 and 9 months after PLC-ER about SRL at Week 52* involved *regular* lesson planning activity. The columns under *During PLC-ER about SRL* involve *reflexive* lesson planning activity.

Table 3.13. Video-recorded lessons

	Week 0	During PLC-ER about SRL				Week 12	Week 52
		After session 1	After session 2	After session 3	After session 4		
Lessons	12	15	13	10	8	11	6
Mean (minutes)	51:55	51:52	54:51	52:32	50:09	53:07	52:00
SD (minutes)	3:00	3:39	6:57	2:27	1:58	3:21	2:52
Max (minutes)	57:39	60:36	76:59	58:22	53:34	61:29	57:29
Min (minutes)	45:41	45:58	50:44	49:39	47:21	49:24	49:34

Robinson and Timperley (2007) argued that there is an "assumption that if teachers [e.g., middle-leaders] learn, then so do their students"; however, they claimed that "this assumption is rarely tested" (p. 248). I included two student measures of SRL (i.e., SRL Process Protocols and Metacognitive Awareness Inventories) to overcome this assumption and evaluate whether changes in middle-leaders and regular classroom teachers' learning improved students' learning (i.e., SRL).

3.7.7. Student SRL process protocol

All middle-leaders taught more than one student group as part of their regular class timetables. School middle-leaders selected only one of their classes to be used in the present study.

The SRL of students within each school middle-leaders' selected class was measured with the *SRL Process Protocol* (Barr, 2017)(refer Appendix L). This paper-based written protocol reflected the three phases of the triadic model of SRL (Zimmerman, 2002) and served a dual purpose; a data collection tool to record student engagement in SRL, and a meta-cognitive prompt for students to promote student SRL. Students within each school middle-leaders' selected class were invited to complete the *SRL Process Protocol* while undertaking a regular classroom activity (e.g., science experiment) prior to the commencement of the PLC-ER about SRL (i.e. pre-test), approximately mid-way through the PLC-ER about SRL (i.e., mid-test) and again at the end (i.e., post-test).

Different from other data analysis methods utilised in the present study, no delayed-post data collection occurred for the *SRL Process Protocols* due to the change in school middle-leaders'

class timetables which occurred between 2018 and 2019. Students gave their completed *SRL Process Protocols* to their class teacher (i.e., school middle-leader), who submitted the protocols for analysis.

3.7.8. Student metacognitive awareness inventory

In addition to the *SRL Process Protocol,* many other instruments have been used by researchers to evaluate students' SRL. Instruments have included observations of students' learning behaviours, students recorded thinking-aloud, academic achievement scores (i.e., performance ratings) and self-report questionnaires. In a review of 123 studies assessing metacognition, a core component of SRL, Dinsmore et al. (2008) reported that self-report questionnaires were the second most frequent data collection instrument used by researchers, only shortly behind performance ratings. Self-report instruments offer a level of "practical usefulness" (Schellings & Van Hout-Wolters, 2011, p. 85), particularly with large cohorts of participants (i.e., students), as they are "cost effective, amendable to large-scale studies, and typically easy to administer and score" (Harrison & Vallin, 2018, p. 16). To overcome the potential pitfalls of self-report measures (e.g., demand characteristics, biased responses)(Harrison & Vallin, 2018), but still benefit from their practical usefulness, I considered a range of self-report instruments for measuring SRL with strong theoretical underpinnings and that had been extensively investigated. These consisted of the Learning and Study Strategies Inventory (LASSI; Weinstein, Schulte, & Palmer, 1987), the Motivated Strategies for Learning Questionnaire (MSLQ; Pintrich, Smith, et al., 1993), and the Metacognitive Awareness Inventory (MAI; Schraw & Dennison, 1994). Schellings and Van Hout-Wolters (2011) suggested that researchers move beyond selecting instruments based on popularity and consider the alignment between desired data and instrument. Acknowledging this recommendation, the LASSI and MSLQ are mainly focused on learning strategies with only a small sub-section devoted to metacognition or SRL, whereas the MAI was designed to evaluate Brown's (1987) dimensions of metacognition: knowledge of cognition and regulation of cognition, making the MAI more aligned with the desired data for the present study.

The MAI was chosen to measure students' SRL before, immediately after and nine months after the PLC-ER that occurred with school middle-leaders. The 52 items in the MAI were factored into two subscales, namely knowledge of cognition and regulation of cognition, with factors shown to be reliable. For instance, "coefficient for Factor 1 (i.e., knowledge of cognition) and Factor 2 (i.e., regulation of cognition) reached .88 and .88, respectively" (Schraw & Dennison, 1994, p. 468). More recently, the MAI has "demonstrated high internal consistency reliability: for the knowledge scale, Cronbach's alpha = .87; for the regulation scale, Cronbach's alpha = .92" (Gutierrez & Schraw, 2015, p. 392).

Researchers have attempted to produce improved versions of the MAI. For example, in a recent study, Harrison and Vallin (2018) employed confirmatory factor analysis and multidimensional random coefficients multinomial logit item-response modelling to evaluate the Metacognitive Awareness Inventory and proposed a new 19 item version. Although the shorter version of the MAI appeared promising, Harrison and Vallin's sample was not randomly selected and only represented university students from one institution, which was substantially different from the present study (i.e., school age students). For this reason, I used the original 52 items in the MAI espoused by Schraw and Dennison (1994). The MAI uses Likert scale response options to 52 questions (e.g., I ask myself periodically if I am meeting my goals; I try to use strategies that have worked in the past). The scale anchors have varied between application (e.g., Gutierrez & Schraw, 2015); however, in the present study, I chose a 7-point scale with the following scale anchors: 1 Very untrue; 2 Untrue; 3 Somewhat untrue; 4 Neutral; 5 Somewhat true; 6 True; and, 7 Very true.

The MAI was delivered via the ACSPRI CANVASS survey platform, during regular class lessons. It typically took 26.02 minutes to complete (Median = 8.13 minutes).

3.7.9. Researcher field notes

Any school-based decisions about timeline, budget and school initiatives associated with sustainability and the school improvement initiatives about SRL were documented in a logbook throughout the study as part of the researcher's field notes.

3.8. Data Analysis

The data set for assessing changes that emerged from the school middle-leaders' PLC-ER about SRL consisted of 16 school middle-leaders' TEC-SRL questionnaire responses, think-aloud transcripts and video-recorded lessons. The data set also included school middle-leaders' 28 students completed SRL Process Protocols, 21 regular classroom teachers' TEC-SRL questionnaire responses and 75 students' Metacognitive Awareness Inventory responses. Participant data were analysed at both individual and group level (i.e., unit of analysis).

Miles, Huberman, and Saldaña (2014) advocated that data collection and data analysis should occur together. They justified this as helping "the field-worker cycle back and forth between thinking about the existing data and generating strategies for collecting new, often better, data" (p. 70). Data were collected and analysed concurrently as per this recommendation.

3.8.1. Responses to TEC-SRL questionnaire

This sub-section considers responses to the TEC-SRL questionnaire. In particular, coding responses, reliability of the coding, screening responses missing data and assessing validity of the analysis. These topics are covered in the following sub-sections.

Coding open-ended question items

Data from open-ended questionnaire items were analysed using both deductive and inductive coding approaches (Creswell, 2014). The deductive coding approach drew on the literature reviewed in Chapter 2 to generate a set of *first iteration codes* (refer first column of Table 3.14). This set of first iteration codes was used in an exploratory analysis of the responses and codes were assigned to text segments (e.g., words, phrases or paragraphs). Text segments that were pertinent to teachers' epistemic cognition about SRL but that did not align with a current code were allocated a new code. As per Miles et al.'s (2014) coding methods, new codes were either descriptive in nature (descriptive coding), indicated an "observable and conceptual action" (process coding), highlighted a participant's values, attitudes or beliefs (value coding), or captured a holistic theme (holistic coding). Any first iteration codes that required modifications were also changed, including the deletion of codes that were deemed unnecessary. A set of *second iteration codes* was established (refer second column of Table 3.14) and applied to responses. However, the excessive number of codes in this set of second iteration codes made coding cumbersome. Reduction of codes resulted in a *final coding scheme* that was used to code all responses (refer third column of Table 3.14). The Coding Manual is included in Appendix O and contains detail regarding individual codes.

Table 3.14. Coding scheme for TEC-SRL questionnaire open-ended responses

First iteration codes (deductive/theory-driven approach)	**Second iteration codes (inductive/data-driven approach)**	**Final coding scheme**
Prior SRL knowledge *Content Knowledge* • Process - Forethought - Performance - Self-reflection • Strategies - Cognitive - Metacognitive - Motivational *Pedagogical Content Knowledge (Reliable process for developing student knowledge about SRL)*	Prior SRL knowledge • *Content Knowledge* - Forethought - Performance - Self-reflection - Metacognition - General • Content Knowledge (strategies) - Cognitive - Metacognitive - Resource Management - Motivational • Pedagogical Content Knowledge *(Reliable process for developing*	Prior SRL knowledge *Content knowledge* • *Metacognitive learning strategies* *Forethought:* - Task Analysis - Self-Motivation *Performance*: - Self-Control - Self-Observation *Self-Reflection*: - Self-Judgement - Self-Reaction • *Cognitive learning strategies* - Rehearsal - Elaboration

First iteration codes (deductive/theory-driven approach)	Second iteration codes (inductive/data-driven approach)	Final coding scheme
- Implicit prompting - Explicit prompting - Implicit strategy instruction - Explicit strategy instruction *Reliable process for assessing student knowledge about SRL* - Observation of student behaviour - Observation of student confidence - Classroom assessment Epistemic stance/ideals Epistemic Vices/Virtues Epistemic Value Perception of Enablers and Barriers • Administrator support/Priority • Staff buy in • Staff capacity to implement • Turnover • Competing initiatives • Community of Practice • Effectiveness • Efficiency • Access to external expertise • Conflict with Personal Beliefs/Mistaken beliefs	*student knowledge about SRL)* - Implicit prompting - Explicit prompting - Implicit strategy instruction - Explicit strategy instruction *Reliable process for assessing student knowledge about SRL* - Observation of student behaviour (including student verbalised feedback) - Assessment task Epistemic stance/ideals • Student behaviour - Willingness to contribute (or withholding inappropriate comments) - Quality of reflection/awareness - Student self-efficacy - Planning - Application of different strategies - Understanding and explanation of SRL skills - General student behaviour *Epistemic vices/virtues (including a reflexive disposition)* *Epistemic value* Perception of Enablers and Barriers • Priority/Administrator support • Staff Buy-In • Staff capacity to implement - Time - Knowledge • Community of practice • Effectiveness • Competing initiatives	• *Resource Management strategies* • *General statements* - Process - Metacognition - Learning strategies - Autonomy - Nil *Pedagogical content knowledge* • *Strategy Instruction* - Explicit - Implicit - General • *Assessment* of student SRL knowledge - Observation - Evaluation sheet - General Epistemic stance/ideals Epistemic vices/virtues (including a reflexive disposition) Epistemic value Perception of Enablers and Barriers • Priority/Administrator support • Staff Buy-In • Staff capacity to implement - Time - Knowledge • Community of practice • Effectiveness • Competing initiatives

A rubric was created, as discussed in Section 2.7, drawn predominantly from the six quality of knowledge categories espoused by Lawson and Askell-Williams (2012): extent, well-foundedness, structure, complexity, generativity, and variety of representational format. The rubric is presented in Table 3.15.

All coded text segments were then assessed for quality using the rubric. Any response that clearly indicated the participant was unsure or did not know was awarded 1 point to represent low-quality knowledge. Any response left blank was recorded as a missing value.

Table 3.15. Rubric for assessing quality of coded text segments

Quality dimensions	1 (Low)	2 (Low-medium)	3 (Medium)	4 (Medium-high)	5 (High)
Extent: quantity of text segments coded	One text segment coded to the relevant category (or indicator of uncertainty).	Two text segments coded to the relevant category.	Three text segments coded to the relevant category.	Four text segments coded to the relevant category.	Five or more text segments coded to the relevant category
Well-foundedness: how well text segments cohere with the evidence	Text segments do not cohere with the evidence.	Text segments loosely cohere with evidence identified in the literature	Text segments somewhat cohere with evidence identified in the literature	Text segments moderately cohere with evidence identified in the literature	Text segments accurately cohere with evidence identified in the literature
Structure: quality of the relationship between coded text segments (i.e., propositions)	Text segments are listed with no connections (i.e. Fragmented knowledge)	Text segments are listed, with limited connections	Text segments are listed with some connections	Text segments are listed with moderate connections	Text segments are listed and closely connected or interrelated
Complexity: level at which the school middle-leader has elaborated within their text segments	Text segments provide no detail or description of an SRL related concept	Text segments provide little detail or description of an SRL related concept (more often implied by a single term)	Text segments provide some detail or description (more often implied by the terms themselves)	Text segments provide a moderate description of an SRL related concept	Text segments provide extensive detail or an extensive description of an SRL related concept
Generativity: range of types of text segments	Only one type of coded text segment listed	Limited range of text segments (i.e., two different types of coded text segments)	Some range of text segments (i.e., three different types of coded text segments)	Moderate range of text segments (i.e., four different types of coded text segments)	Extensive range of text segments (i.e., Five or more different types of coded text segments)
Variety of representational format: different forms in which knowledge is stored	Text segments reflect a single cognitive representation	Text segments reflect limited diversity in cognitive representations (i.e., two)	Text segments reflect some diversity in cognitive representations (i.e., three)	Text segments reflect a moderate diversity in cognitive representations (i.e., four)	Text segments reflect many and diverse cognitive representations (i.e., five or more)

Assessing reliability of coding open-ended question items

Intra-rater reliability was assessed six weeks after all responses were coded (excluding delayed-post measures). Two middle-leaders' responses were randomly selected (using the Microsoft® Excel Index function) and blind-coded again. Intra-rater agreement was *almost perfect*, κ = .968, 95% CI [.923 to 1.013], *p< .001.*

To calculate inter-rater reliability, an external coder (Ph.D. student and teaching colleague) was used. He had taught alongside the researcher in a Master of Education topic which encompassed teaching about SRL. Additionally, the external coder previously conducted research in the field of teachers' beliefs about learning and was currently engaged in research in the field of student social and emotional learning competencies. Both areas of his research shared elements with the present study and provided good reason for this individual to be selected for inter-rater coding.

The external coder training was a carefully structured 3-hour program with the researcher. Studies (e.g., Dignath-van Ewijk et al., 2013; Hoyt, 2000) have highlighted the importance of coder training as a method to minimise variability in subjective interpretations through the development of shared meanings of codes. The training required the external coder to develop a sound understanding of the coding manual (Appendix O) and its application to TEC-SRL open-ended questionnaire responses. He was encouraged to ask any questions throughout the training.

First, the theoretical background of the questionnaire and the coding manual were explained to the external coder. Each of the codes was then unpacked and a shared meaning distilled, discussions that served a dual purpose to clarify meaning and to develop awareness of any personal orientations for meaning. When the external coder indicated confidence with the coding procedure, two sets of middle-leader responses were coded collaboratively. The coder then blind coded two randomly selected responses (using the Microsoft® Excel Index function). Inter-rater reliability revealed *strong* agreement between the two raters, κ = .870, 95% CI [.786 to .954], *p< .001.*

Different guidelines regarding acceptable rater reliability exist in papers discussing rater-bias and reliability (e.g., Landis & Koch, 1977; McHugh, 2012). Drawing on contemporary interpretations, McHugh (2012) reported how Cohen's kappa could be interpreted (refer Table 3.16). McHugh advocated that "many texts recommend 80% agreement as the minimum acceptable interrater agreement" (p. 278). Following this advice, strong agreement (Cohen's kappa value of .80-.90) was considered the minimum benchmark for reliability scores in the present study.

Table 3.16. Interpretation of Cohen's kappa (McHugh, 2012)

Value of kappa	Level of agreement	Reliable Data (%)
0-.20	None	0-4%
.21-.39	Minimal	4-15%
.40-.59	Weak	15-35%
.60-.79	Moderate	35-63%
.80-.90	Strong	64-81%
Above .90	Almost Perfect	82-100%

Screening responses to closed-ended question items

Data from closed-ended questionnaire items underwent a process of case and variable screening. Data were exported from the CANVASS survey platform into a Microsoft® Excel spreadsheet for initial processing. Response sets with substantial missing values (more than ten percent) or a standard deviation of 0 were to be discarded. Remaining response sets were to be imported into SPSS and missing values were replaced using the SPSS function "median of nearby points". Missing values were deemed suitable for replacement as they followed no obvious pattern, randomly placed across middle-leaders and questions. Outliers were less relevant due to responses existing on a Likert scale 1-7; however, middle-leaders' and teachers' demographics were visually screened for any outliers or inconsistencies (e.g., number of years teaching experience and age).

Results can be seen in Table 3.17, which documents discarded response sets from middle leaders and teachers, number of missing values replaced and minimum and maximum standard deviations.

Table 3.17. Screening questionnaire response sets

	Middle-leaders			Teachers		
	Week 0	Week 12	Week 52	Week 0	Week 12	Week 52
Submitted response sets	15	11	6	18	11	4
Response sets with ≥10% missing values (discarded)	0	0	0	0	0	0
Response sets with a standard deviation of 0 (discarded)	0	0	0	0	0	0
Response sets remaining	15	11	6	18	11	4
Replaced missing values	4	4	0	1	0	0
Standard deviation (min)	1.20	1.01	1.12	0.88	1.02	1.20
Standard deviation (max)	2.02	1.75	1.68	1.73	1.81	1.88

No responses were discarded, with all 65 response sets being retained (32 middle-leaders, 33 teachers). The standard deviation ranged from 0.88 to 2.02 indicating reasonable engagement and highlighting that these cases could now progress to the next stage of analysis.

Assessing validity and significance of responses to questionnaire

As the TEC-SRL questionnaire was a newly constructed questionnaire, common statistical measures for validation such as Confirmatory Factor Analysis (CFA) and Exploratory Factor Analysis (EFA) were explored. Unfortunately, these statistical measures require 100 or more cases (Field, 2018), a requirement the present study was unable to meet. Due to the small sample, middle-leaders' responses to the TEC-SRL questionnaire were not normally distributed. A series of non-parametric Wilcoxon Signed Ranks Tests and Friedman tests were selected, being deemed suitable as they are used to compare within-group participants over two or three different points in time (Field, 2016). Conducting a Bonferroni correction to account for potential family-wise error was considered. However, in this thesis, a more sophisticated judgement was required to ensure that conceptual items that might contribute to future research were not excluded at such an early stage of conceptual development. In statistical terms, this means that the balance between avoiding Type I errors (false positives) and Type II errors (false negatives) needed to be shifted towards avoiding Type II errors. Accordingly, the method selected in the thesis was to retain the 0.05 significance level, as recommended by Sullivan and Feinn (2012) and supported by the correlation (r) as the effect size for each calculation. This more nuanced assessment of the balance between Type I and Type II errors is more valid for the goals of this project/thesis.

Descriptive statistics, namely means, standard deviations for each time (i.e., Week 0, Week 12 and Week 52) and difference between times (i.e., change scores, Week 12 minus Week 0, Week 52 minus Week 0) were calculated using SPSS. Effect size was assessed following guidelines (*r=z score/square root [N*]) outlined by Field (2018), and in accordance with Cohen (1992) criteria; .1 for a small effect, .3 for a medium effect and .5 for a large effect.

3.8.2. Think-aloud transcripts and lesson plans

This subsection considers the think-aloud transcripts and lesson plans from school middle-leaders, in particular their coding, validity and reliability.

Coding think-aloud transcripts and lesson plans

Think-aloud analysis (Ericsson & Simon, 1980, 1993) was undertaken with middle-leaders' think-aloud transcripts and lesson plans. All transcripts and lesson plans were blind-shuffled and each was read carefully while listening to the matching audio-recording. This allowed for first

impressions, such as comments or questions, to be annotated and nuances in tone and pace of voice to be identified. Transcripts and lesson plans were then re-read and divided into text segments (for example, words, expressions and paragraphs) that represented a single unit of meaning. Text segments were coded using the coding scheme (Table 3.14). Text segments that were pertinent to epistemic cognition of middle-leaders about SRL but did not align with a current code were allocated a new code. This predominantly involved allocation of the new process codes outlined in Table 3.18.

Table 3.18. Process codes added to coding scheme (Table 3.14)

First iteration codes (deductive/theory-driven approach)	Second iteration codes (inductive/data-driven approach)	Final coding scheme
Setting of epistemic aims (for self and/or learners)	Setting of epistemic aims For learner: • Knowledge • Understanding • True belief For self: • Knowledge • Understanding • True belief	Setting of epistemic aims For learners: • Knowledge • Understanding • True belief For self: • Knowledge • Understanding • True belief
Selection and Use of *reliable processes*	Selecting [reliable] processes: • For learners • For self	Selecting [reliable] processes: • For learners • For self
Consideration and Evaluation of *epistemic matters*	Consideration and Evaluation of epistemic matters	Consideration and Evaluation of epistemic matters: • For learners • For self

In Table 3.18, there are three final category codes: setting of epistemic aims, selecting reliable processes and consideration and evaluation of epistemic matters. Each of these category codes relate to the *deliberation* and *decision* moments of the process of epistemic reflexivity (i.e., DDD-D process model of epistemic reflexivity). Categorised text segments were then coded for quality using the same quality rubric applied to text segments for school middle-leaders' open-ended responses in the TEC-SRL questionnaire (refer Table 3.15).

Assessing validity of think-aloud transcripts and lesson plans

As thinking-aloud was audio-recorded and transcribed, data available in think-aloud transcripts are argued as descriptively valid (Huberman & Miles, 2002). Ericsson and Simon (1993) suggested three criteria "as necessary conditions to be satisfied by verbal data if they [were] to be used to infer underlying cognitive processes [i.e., to be valid]" (p. 171). The three criteria were *relevance*

(i.e., related to the activity), *consistency* (i.e., follow a logical sequence*) and memory* (i.e., evident that the participant draws on their memory). All think-aloud audio-recordings matched the lesson planning activity and were considered *relevant*. Furthermore, from analysis of think-aloud transcripts, it was clear that verbalised thoughts followed a logical sequence and were *consistent*. Ericsson and Simons' *memory* criterion, that participants verbalise "the same information [drawing on their memory] at two different parts of a protocol" (p. 172) was also apparent in the school middle-leaders' thinking-aloud. The thoughts verbalised during a think-aloud can be argued as sufficient to represent the school middle-leaders' epistemic cognition that occurred when middle-leaders engaged in lesson planning.

Assessing reliability of coding of transcripts and lesson plans

Intra-rater reliability was assessed six weeks after all transcripts and lesson plans were coded (excluding delayed-post measures). Two middle-leaders' transcripts were randomly selected (using the Microsoft® Excel Index function) and recoded blind for pre-post intervention. Intra-rater reliability was *almost perfect*, κ = .949, 95% CI [.892 to 1.006], *p< .001.*

To calculate inter-rater reliability, an external coder (refer Section 3.8.1) was used. To minimise rater bias (Hoyt, 2000; Hoyt & Kerns, 1999), the coder underwent an additional 1.5. hours of training for coding think-aloud transcripts, which training required the external coder to further develop his understanding of the coding manual (Appendix O), particularly the addition of new process codes (Table 3.18) and their application to the think-aloud transcripts.

Together, with the researcher, the coder unpacked each of the new process codes and shared meaning was distilled through discussion. When the coder indicated confidence with the coding procedure, one think-aloud transcript was coded collaboratively. Codes were discussed and any inconsistencies clarified. The coder then blind-coded two think-aloud transcripts that were selected based on the inclusion of a broad range of codes, presence of sufficient text segments for calculating an inter-rater reliability score and being deemed (by researcher and an expert) as an achievable inter-rater task. Inter-rater reliability revealed *strong agreement* between the two raters, κ = .863, 95% CI [.777 to .949], *p< .001.*

3.8.3. Video-recorded lessons

Video-recorded lessons formed the primary measure of middle-leaders' teaching practice. This subsection considers coding and reliability of these videos.

Coding of video-recorded lessons

The *Assessing How Teachers Enhance Self-Regulated Learning* (ATES; Dignath-van Ewijk et al., 2013) observation instrument was used (with permission) to measure middle-leaders' teaching

practice about SRL. The ATES observation instrument evaluates teachers' SRL strategy instruction and elements of the classroom environment related to promotion of SRL. The ATES observation instrument has been demonstrated to be reliable and valid in German and Swiss schools (Dignath & Büttner, 2018; Kistner et al., 2015) and Flemish schools (De Smul, Van Keer, Heirweg, & Devos, 2017).

Video-recorded lessons varied in length (refer Table 3.19). To allow fair comparison of microgenetic changes over time, all videos were shortened to 45 minutes (equal to the shortest video recorded). Where possible, video segments that represented non-teaching time (e.g., students arriving or packing up at the end of the lesson) were first removed to maximise possibility of observing explicit teaching of SRL strategies. Next, any teaching-time that exceeded the first 45 minutes was also discarded. Then, as per the manual provided with the ATES observation instrument, I watched the 45 minute videos and coded 1-minute segments against the ATES observation instrument. If a form of strategy instruction occurred, the number 1 was recorded in the corresponding time block. If no strategy instruction occurred, the time block was left blank.

Table 3.19. Length of school middle-leaders' video recorded lessons

		During the PLC-ER about SRL					
ID	**Week 0**	**After session 1**	**After session 2**	**After session 3**	**After session 4**	**Week 12**	**Week 52**
ML1	52:48	54:24	52:43	-	-	49:24	-
ML2	55:06	57:01	58:55	49:39	49:48	53:29	50:14
ML3	45:41	45:58	-	51:37	-	52:34	57:29
ML4	51:08	52:08	76:59	50:36	51:17	50:14	Not employed
ML5	57:39	49:41	52:52	58:22	53:34	61:29	52:34
ML6	-	51:57	-	51:34	-	56:05	Personal leave
ML7	(video error)	50:08	50:51	53:22	50:45	52:44	-
ML8	52:43	51:35	52:42	54:34	50:35	53:32	51:09
ML9	52:37	51:20	51:27	51:22	47:21	50:23	49:34
ML10	51:49	60:36	54:05	52:16	50:10	51:29	51:02
ML11	50:16	51:32	50:44	-	47:49	-	Personal leave
ML12	-	-	-	-	-	-	-
ML13	50:20	50:30	53:13	52:03	-	-	-
ML14	53:41	54:27	52:52	Withdrawn	Withdrawn	Withdrawn	Withdrawn
ML15	49:24	47:34	54:13	-	-	-	-
ML16	-	49:10	51:37	-	-	52:58	Withdrawn

Assessing reliability of coding of video-recorded lessons

Intra-rater reliability was assessed six weeks from the date of completion of the coding process. Two 15-minute video segments were randomly selected (using the Microsoft® Excel Index function) and re-coded. Intra-rater agreement was *strong*, κ = .841, 95% CI [.782 to .9], *p< .001*].

Spruce and Bol (2015) calculated inter-rater reliability for 20% of their video-recorded observations using two coders. Dignath and Büttner (2018) also used two coders, but did not specify percentage of videos used to calculate inter-rater reliability. Hoyt (2000) recommended training "a smaller number of observers and… [having] all observers rate each target" (p. 83). Taking into consideration Hoyt's recommendation and the methods adopted in previous studies, the previously enlisted external coder was engaged to minimise rater bias (Hoyt, 2000; Hoyt & Kerns, 1999).

Hoyt and Kerns (1999) indicated that coder-training increases shared meaning and reduces rater bias. Research studies that adopt small training (0-5 hours) typically use highly structured coding processes that are considered easy to pick up and apply (Hoyt, 2000).

To calculate inter-rater reliability, an external coder was used. As the ATES coding manual and observation instrument are highly-structured, a 2-hour training program was deemed appropriate for the present study. The coder was stepped through the ATES observation instrument, ATES coding manual and examples of observed behaviours/teacher statements for each code. Each code was discussed with the external coder to clarify meaning and develop awareness of personal orientations for meaning. When the external coder indicated confidence with applying the ATES manual, two 15-minute video segments were coded collaboratively. Each code was discussed to clarify understanding. Next, the external coder coded two 15-minute video segments independently. Inter-rater reliability was *strong*, κ = .892, 95% CI [.794 to .990], *p< .001*].

3.8.4. Student SRL process protocols

A total of 186 students' SRL Process Protocols were collected from students in selected classes of the school middle-leaders. Student IDs on the SRL Process Protocols were visually inspected and if no student ID number was listed or the ID has no corresponding parental consent, the SRL Process Protocol was discarded (see Table 3.20).

The remaining SRL Process Protocols (n=79) were assessed using a rubric (Table 3.21) that was developed on the basis of the triadic model of SRL (Zimmerman, 2002) and previous studies with similar protocols (e.g., Eilam & Reiter, 2014). A total of 49 marks was available and divided as follows: Forethought – 17 points, Performance – 15 points, and Self-reflection – 17 points. Rubric

scores for each sub-scale (i.e., Forethought phase, Performance phase and Self-Reflection phase) were entered into an SPSS data file.

Table 3.20. Selection of student SRL Process Protocols

	Times		
	Week 0	**Week 6**	**Week 12**
Submitted response sets	69	98	19
Response sets with missing student ID number (discarded)	13	13	4
Response sets with no matching parental consent form (discarded)	23	49	5
Remaining number of response sets	33	36	10

Table 3.21. Rubric for assessing student SRL Process Protocols

Phases and sub-sections of Zimmerman's triadic model	Sub-criterion	Corresponding item from SRL Process Protocol	1	2	3	4	5
Forethought: Task Analysis	Goal-setting	What's my goal?	Incoherent or not listed	Goal is listed **but only addresses very limited aspects of a** Specific, Measurable, Achievable, Relevant and Time-bound* (SMART) goal. *E.g., "to fully understand French verbs"*	Goal **demonstrates some elements** of a Specific, Measurable, Achievable, Relevant and Time-bound* (SMART) goal. *E.g., "To fully understand and use the 4x French expressions"*	Goal **demonstrates most elements** of a Specific, Measurable, Achievable, Relevant and Time-bound* (SMART) goal. *E.g., "To finish the English to French verb page"*	Goal clearly reflects **all elements** of a Specific, Measurable, Achievable, Relevant and Time-bound* (SMART) goal. *E.g., "To finish the English to French verbs (x10) on page 1 by the end of the lesson"*
	Strategic planning	What strategies do I plan to use?	Incoherent or not listed	**One or more vague strategy statements are listed**, but do not provide sufficient detail as to what the strategy is or entails. *E.g., "Limiting all distractions, making sure I finish it by a certain time"*	**At least one defined strategy is clearly identifiable**, and flows appropriately from the listed goal. *E.g., "Limiting all distractions, no phone or computer within reach"*	**At least two defined strategies are clearly identifiable**, and flows appropriately from the listed goal. *E.g., "Limiting all distractions, no phone or computer within reach and sit away from friends"*	**Two or more strategies are clearly listed, flow appropriately from listed goal, and provide sufficient detail for easy replication**. *E.g., "No phone or computer within reach, create a single flashcard for each key definition and rehearse 4 times"*
Forethought: Self-motivation beliefs	Assessment of self-efficacy	My self-belief for this task is…**	Incoherent or not listed	Response listed			
	Justification of self-efficacy	Explain.	Incoherent or not listed	An attempt to explain the self-efficacy rating **is listed, but does not present clear justification.** *E.g., "I feel confident"*	A **very basic explanation** related to confidence is provided for the self-efficacy rating. *E.g., "I'm feeling more confident about verbs", "I think I might be able to memorise the endings of the verbs"*	A **suitable and basic justification** is provided for the self-efficacy rating. *E.g., "Because I already know a few phrases and key words"*	Self-efficacy rating is clearly justified with a **well-described explanation** *E.g., "by using repetition I will be able to memorise things a lot quicker"* *"I've already done a first draft, so now I'm just rewriting/refining"*
Performance: Self-observation	Monitoring of strategies	Are my chosen strategies working?	Incoherent or not listed	Response listed			
		If YES, how do I know my strategies are working for me?	**Incoherent or not listed**	The justification for strategy monitoring assessment is listed but **unclear.** *E.g., "my strategy is working"*	The justification for strategy monitoring assessment is **limited.** *E.g., "because I am making progress in completing my theory sheet"*	The justification for strategy monitoring assessment is **clear but lacks detail.** *E.g., "because I'm starting to memorise the presentation and getting familiar with it"*	The justification for strategy monitoring assessment is **well-described and explained.** *E.g., "because after resting for a bit and going back to test my knowledge, I still remember the terms before", "because I finished a paragraph"*
		If NO, how will I modify my strategies?	Incoherent or not listed	A strategy modification is listed but that modified action is **unclear.** *E.g., "try harder", "stop getting distracted", "block out noise", "sit away", "don't be distracted by everything"*	A **very basic** strategy modification is listed *E.g., "be more realistic towards my goals considering I have to leave class halfway through"*	A **basic and suitable strategy** modification is clearly listed. *E.g., "Say in my mind 'stop'"*	The strategy modification is **well-described and explained** *E.g., "I need to ensure that my computer is fully charged before coming to school"*

Performance: Self-control	Time management	Am I managing my time?	No	Both: No & Yes (or Maybe)	Yes		
	Attention focusing	Am I managing any distractions?	No	Both: No & Yes (or Maybe)	Yes		
	Help-seeking	Am I seeking help?	Incoherent or not listed	Response listed			
Self-reflection: Self-Judgement	Evaluation of success	Did I…	Incoherent or not listed	Response listed			
	Explanation of attribution	What was the reason for my success/failure?	**Incoherent or not listed**	The reasons for success/failure (i.e. attributions) are **listed but unclear.** *E.g., "Because I worked hard"*	The reasons for success/failure (i.e. attributions) are **only briefly described (lacks detail)**. Description offers little to no clear explanation of attribution. *E.g., "Partially succeeded - Because I concentrated. I didn't fully finish because I did get distracted", "didn't fully implement my feedback"*	The reasons for success/failure (i.e. attributions) are **clearly**, **but only briefly described** and justify previous attribution. *E.g., "I managed my time well and focused on what I needed to be doing", "didn't get distracted", "I stayed focused and used my time well"*	The reasons for success/failure (i.e. attributions) are **well-described and explained** *E.g., "I succeeded as concept mapping allowed me to organized my thinking about this topic", "time-blocking increases my focus and enabled me to complete all the necessary tasks"*
	Evaluation of strategy	Describe the effectiveness of the strategies used:	**Incoherent or not listed**	Evaluation of strategies **only lists the level of effectiveness** with no description/explanation. *E.g., "Not very effective"*	**Limited evaluation of strategies** *E.g., "Partially effective because I got distracted when working with people"*	A **basic evaluation** of the effectiveness of the strategies is provided. *E.g., "Breaks give you time to think and focus well", "When I did block people out it was good, but I got distracted in the second half"*	**Well-described and explained** evaluation of the effectiveness of the strategies used *E.g., "The [strategy] was highly effective and helped me remember all the terms"*
Self-reflection: Self-reaction	Future adaptation	Will you change anything next time? (Explanation provided)	**Incoherent or not listed** (Simple Yes/No with no explanation)	Some attempt to list future actions/changes is evident, but future actions/changes **lack detail for actual implementation** *E.g., "I will aim to stay focused"*	Future actions/changes are listed but **limited in detail**. *E.g., "No - The method already worked for me", "Avoid distractions"*	**Basic details** of future actions/changes are provided. Actions are listed with enough detail for implementation. *E.g., "Yes – sit away from friends"*	Future actions/changes are **well-described and explained**. *E.g., "Make sure I have 5-10 minute break so I can regroup and relax for a bit, before I focus back on the work"*
						FORETHOUGHT total score:	
						PERFORMANCE total score:	
						SELF-REFLECTION total score:	
						SRL TOTAL score	

To calculate a single score for a student SRL (using the SRL Process Protocol rubric), 'Performance' scores were rescaled to a 17-point scale using a lower and upper limits method described by De Vaus (2002, pp. 108-109). This enabled the 'Performance' score to be comparable to both 'Forethought' and 'Self-Reflection' scores. Following rescaling, a mean of scores was calculated as single factor score for student.

Assessing reliability of coding of student SRL Process Protocols

Intra-rater reliability was assessed two weeks from the date of completion of the rubric marking process. Fifteen SRL Process Protocols were randomly selected (using the Microsoft® Excel Index function) and re-assessed using the rubric. Intra-rater agreement was *strong*, κ = .844, 95% CI [.785 to .903], *p< .000*].

Based on the justification that coder-training increases shared meaning and reduces rater bias (Hoyt & Kerns, 1999), an external coder (a previous teaching colleague) was used to establish inter-rater reliability of assessments of SRL Process Protocols. The external coder had previously completed the Graduate Certificate of Education (Cognitive Psychology and Educational Practice) at Flinders University and was familiar with content about SRL. As the SRL Process Protocol and accompanying rubric were highly structured, a 1-hour training program was considered sufficient (Hoyt, 2000).

The external coder was stepped through the SRL Process Protocol, accompanying SRL Process Protocol Rubric, examples of student responses and how these were marked against the rubric. Each marking criterion was discussed in order to clarify meaning and develop awareness of personal orientations for meaning. When the external coder indicated confidence with applying the SRL Process Protocol Rubric to the SRL Process Protocols, two SRL Process Protocols were marked collaboratively. Each mark was discussed to clarify understanding. The external coder then coded 15 SRL Process Protocols independently. Inter-rater reliability was *strong*, κ = .868, 95% CI [.813 to .923], *p< .000*].

3.8.5. Metacognitive awareness inventory responses

Data from the Metacognitive Awareness Inventory (MAI) was screened according to guidelines by Field (2018).

Response sets with more than ten percent missing values were discarded, as were sets that did not have an identification number. Responses with a standard deviation of 0 were also discarded. Results for the remaining 75 responses are contained in Table 3.22 and indicate reasonable student engagement in the MAI.

Table 3.22. Selection of student MAI response sets

	Times		
	Week 0	**Week 12**	**Week 52**
Submitted response sets	182	152	111
Response sets with ≥10% missing values (discarded)	1	3	4
Response sets missing ID (discarded)	18	7	1
Response sets with standard deviation of 0 (discarded)	0	0	0
Remaining response sets	163	142	106
Standard deviation for remaining response sets (minimum)	0.47	0.44	0.48
Standard deviation for remaining response sets (maximum)	2.13	2.38	1.96

The cleaned data set was imported into SPSS. Remaining missing values (n=226) were replaced using the SPSS function ‘median of nearby points’. Missing values were deemed suitable for replacement as they followed no obvious pattern and were randomly placed across participants and questions. Outliers were less relevant due to responses existing on a Likert scale. Participant demographics were visually screened for any outliers or inconsistencies (for example, age and year level).

Confirmatory factor analysis (CFA) was conducted with the eight theoretical factors from the MAI using Amos (Version 26) and followed documented recommendations for model fit (Schumacker & Lomax, 1996). CFA involves the testing of factor unidimensionality by confirming the underlying theoretical grounds of a model. Initial model identification is a requirement of CFA, which in turn generates modification indices and standardised loadings (standardised regression weights). Anderson and Gerbing (1988) suggested that deleting the indicator from the model was a preferred basic way to achieve a better model fit. Any removal of items in this iterative process results in changes in the parameters and model fit statistics. Results from conducted CFAs are reported in Chapter 8.

The confirmed factors were tested for reliability using Cronbach’s alpha (α), for which there are varying published guidelines. For example, Nunnally (1978) suggested that 0.7 was an acceptable reliability score for exploratory or preliminary research, with the higher cut-offs for either basic or applied research. George and Mallery (2003) proposed a tiered approach “≥ .9 – Excellent, ≥ .8 – Good, ≥ .7 – Acceptable, ≥ .6 – Questionable, ≥ .5 – Poor, and ≤ .5 – Unacceptable” (p. 231). More recently, Hair, Black, Babin, and Anderson (2010) suggested that .6 might be more acceptable for the preliminary stages of research. As this study was a preliminary study, including the application of the MAI to the secondary school context, it was important to acknowledge the exploratory nature of the research; however, given the

consensus in the literature (Field, 2018; George & Mallery, 2003; Nunnally, 1978), I chose to stay with .7 as an acceptable cut-off, but to use the George and Mallery tiered approach to better acknowledge the range of reliability.

Mean, SD and range were also calculated for each confirmed factor and at varying data-collection point: before, immediately after and 9 months after the PLC-ER about SRL.

3.8.6. Researcher field notes

Any field notes were re-read and where suitable, coded using the previously discussed coding approach and categories.

3.9. Guide to Subsequent Results and Discussion Chapters

The following results and discussion chapters are ordered according to each research question as visually represented in Figure 3.3.

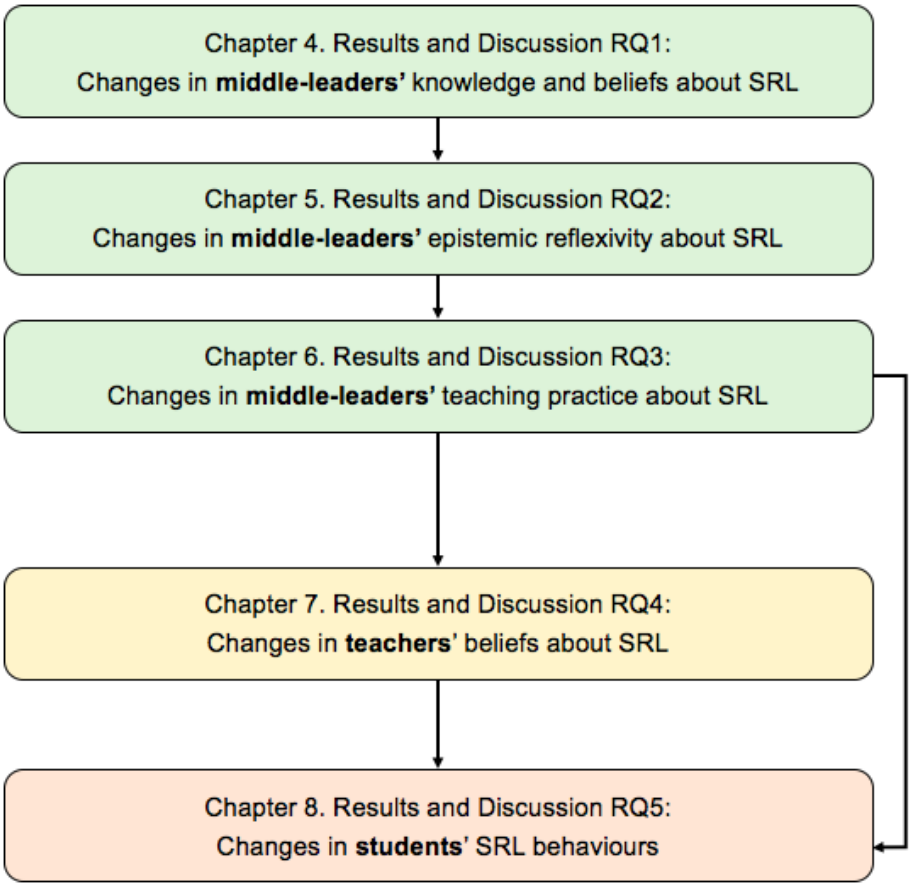

Figure 3.3. Flow chart of Results and Discussion chapters

Figure 3.3 indicates that Chapters 4 through 6 focus on the changes that emerged for school middle-leaders as they participated in the PLC-ER about SRL. Chapters 7 and 8 focus on the changes that emerged in teachers and students respectively.

4. RQ1: CHANGES IN MIDDLE-LEADER KNOWLEDGE AND BELIEFS

This chapter reports results related to my first set of research questions (detailed earlier at Section 2.8.2), namely:

- (RQ1a) What is the nature of the changes in middle leaders' knowledge and beliefs about SRL in response to a PLC-ER about SRL?
- (RQ1b) Are the changes in middle leaders' knowledge and beliefs about SRL sustained over time?

To answer my first set of research questions and evaluate related hypotheses, I collected and analysed school middle-leaders' responses to the TEC-SRL questionnaires (refer 3.7.2). Results are reported and discussed in the following sections.

These sections show that my hypotheses related to changes in middle-leaders' knowledge and beliefs about SRL were generally *supported*, in that:

- (H1a) Changes in middle leaders' knowledge and beliefs were qualitative and quantitative (i.e., path of change), slow (i.e., rate of change), domain-specific (i.e., breadth of change), substantially varied across similar tasks and middle leaders (i.e., variability of change), were aligned in time with the PLC-ER about SRL, were not accounted for by any other observable substantial changes in the participating school's focus or professional education opportunities, and therefore were arguably in response to a PLC-ER about SRL (i.e., source of change).
- (H1b) Variable changes were sustained 9-months after the conclusion of the PLC ER about SRL.

It should be noted that during the study described in this chapter, there was substantial participant attrition by the end of the data collection period. This is addressed in more detail in the Limitations section of this thesis (refer Section 10.1.1).

4.1. Changes in Middle-Leader Knowledge

4.1.1. Changes in content knowledge

As described in the Method chapter, middle-leaders' content knowledge about SRL was measured using the quality rubric (introduced at Table 3.15) to score the quality of their responses to three TEC-SRL open-ended items:

- **Item 1.** According to you: What is SRL?
- **Item 2.** What are the 'types' of things your students need to know to self-regulate their learning well?

- **Item 3.** What knowledge is necessary for effective teaching about SRL?

Means for middle-leaders' quality of content knowledge about SRL are reported in Table 4.1. These means include: pre-intervention, immediate post-intervention and long-term post-intervention, difference between pre-intervention and immediate post-intervention and difference between pre-intervention and long-term post-intervention.

Table 4.1. Means for middle-leader quality scores of content knowledge about SRL

Participant ID	Mean			Change score	
	Week 0 (n = 15)	Week 12 (n = 11)	Week 52 (n = 6)	Week 12 minus Week 0	Week 52 minus Week 0
ML1	3.50	3.50	4.00	0.00	0.50
ML2	2.67	4.17	3.83	1.50	1.16
ML3	2.67	NR	-	NR	-
ML4	3.17	3.33	NE	0.16	NE
ML5	2.50	2.67	2.00	0.17	-0.50
ML6	1.67	1.83	A	0.16	A
ML7	2.50	2.67	3.00	0.17	0.50
ML8	2.67	3.33	3.83	0.66	1.16
ML9	-	2.67	4.17	-	-
ML10	2.00	-	-	-	-
ML11	2.00	NR	A	NR	A
ML12	1.00	2.83	-	1.83	-
ML13	3.00	-	-	-	-
ML14	2.67	W	W	W	W
ML15	2.67	-	-	-	-
ML16	3.33	-	NE	-	NE
Total change				4.65	2.82
Mean change				0.58	0.56

'-' = Questionnaire not completed, NR = Questionnaire completed with no response, NE = No longer employed on site, A = Absent – on leave, W = Withdrawn

Table 4.1 shows that prior to the PLC-ER about SRL at Week 0, the quality of middle-leaders' content knowledge about SRL ranged from low to medium. A finding that is consistent with previous studies about classroom teachers (Barr & Askell-Williams, 2020a; Dignath-van Ewijk & van der Werf, 2012; Spruce & Bol, 2015). Immediately after the PLC-ER about SRL at Week 12, middle-leaders demonstrated growth in the quality of their content knowledge about SRL; however, this growth varied from minimal (e.g., ML4, ML5, ML6 and ML7) to substantial (e.g., ML2 and ML12). Nine months after the PLC-ER about SRL at Week 52, the remaining

participating middle-leaders continued to demonstrate growth in their content knowledge about SRL, except for ML5 who demonstrated a slight decrease.

A non-parametric Wilcoxon Signed-Ranks Tests was calculated on matched middle-leaders' (n=8) mean quality scores for content knowledge about SRL and indicated an *increase* from Week 0 (*Median* = 2.67) to Week 12 (*Median* = 2.83). This result was *statistically significant*, z = -2.410, p = 0.016 and it showed a medium to large effect size of *r* = -0.49. As stated in the Method chapter (refer 3.8.1), effect size was assessed following guidelines (i.e., *r* = *z score/square root of* number of cases) outlined by Field (2018) and in accordance with Cohen (1992) criteria: 0.1 for a small effect, 0.3 for a medium effect and 0.5 for a large effect. Statistical measures were not conducted with Week 52 scores due to low sample sizes caused by participant attrition.

Table 4.1 reported changes in individual middle-leaders' mean quality scores over time. Figure 4.1 provides an alternative view to consider the nuanced changes between the six quality dimensions (e.g., extent, well-foundedness) of content knowledge about SRL that appear in the quality of knowledge rubric.

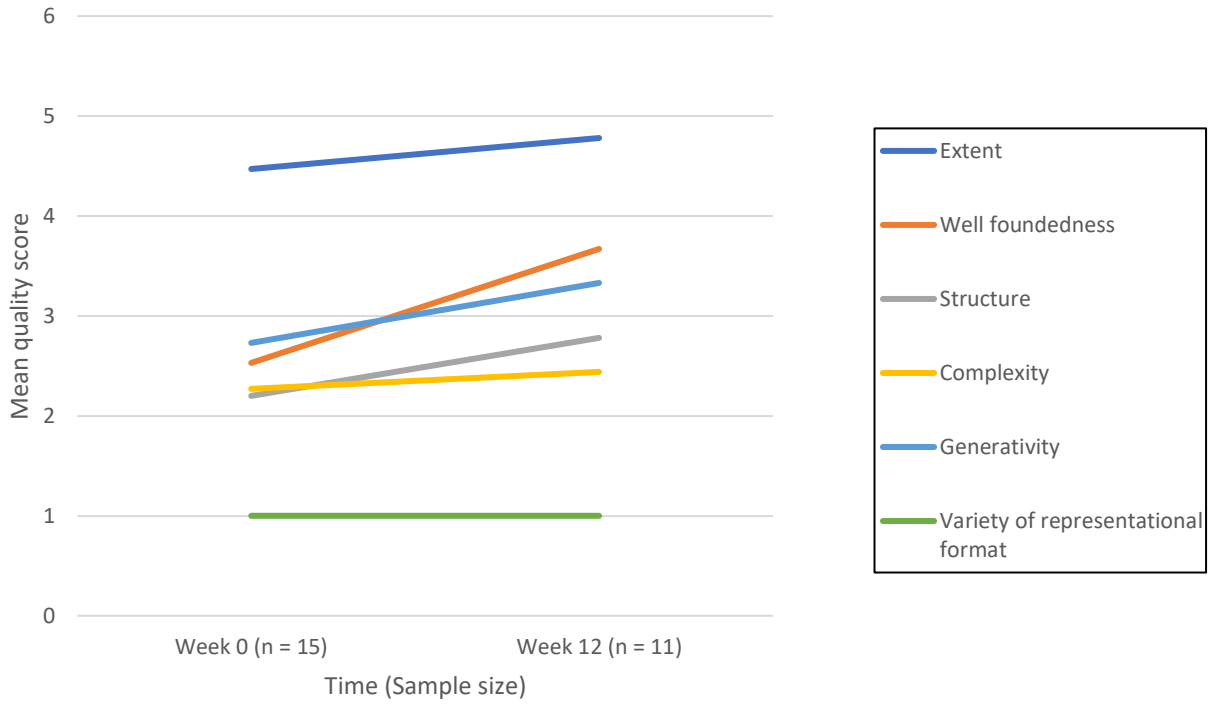

Figure 4.1. Means for quality dimensions of middle-leader content knowledge

Figure 4.1 shows that before the PLC-ER at Week 0, middle-leaders demonstrated a high number of text segments (extent) related to content knowledge about SRL. However, inspection of mean scores for the remaining quality dimensions showed relatively low scores as middle-leaders' text segments were vague about SRL. For example, ML3 stated "SRL is when students are responsible for their learning" (Week 0) and ML11 stated "how to check their

own understandings" (Week 0) which are both correct but included little further detail about what that specifically involved. My use of the quality of knowledge rubric (refer Table 3.15) evaluated middle-leaders' content knowledge about SRL as being relatively impoverished, as they did not include, for example, specific explanations of SRL as a process, the individual SRL phases (Forethought, Performance, Self-reflection), nor the specific sub-component of each phase (e.g., task analysis, goal-setting). Immediately following the PLC-ER about SRL at Week 12, middle-leaders demonstrated *growth* in the quality of their content knowledge about SRL most notably in the dimension of *well-foundedness*, suggesting that as middle-leaders engaged in a PLC-ER, their content knowledge about SRL achieved greater alignment with the current literature and best practice about SRL. For example, ML4 reported that students' SRL is "how they continuously evaluate their learning. [i.e., monitoring and evaluating]"; "how to set goals"; "and evaluate their goals" (Week 12), while ML1 described SRL as "the process of setting goals, planning how you will achieve them and setting those plans in motion, evaluating whether you have achieved your goals and whether your strategies worked and starting all over again in a reflective cycle" (Week 52). Further analysis of content knowledge statements at Week 52 showed a positive trend for the remaining participants, but substantial participant attrition precludes my making definitive claims about long-term improvements in middle-leaders' quality of content knowledge. Additional examples of middle-leaders' text segments coded against each quality dimension (e.g., extent, well-foundedness) can be found in Appendix Q.

4.1.2. Changes in pedagogical content knowledge

As described in the Method chapter, changes in middle-leaders' pedagogical content knowledge about SRL was measured by using the quality rubric (introduced at Table 3.15) to score the quality of their responses to two TEC-SRL open-ended items:

- **Item 31.** What is the best way to teach students SRL? Why?
- **Item 34.** What is the best way to assess students' SRL? Why?

Means and standard deviations for the quality of pedagogical content knowledge about SRL for each middle-leader are reported in Table 4.2. These means include: pre-intervention, immediate post-intervention and long-term post-intervention, difference between pre-intervention and immediate post-intervention and difference between pre-intervention and long-term post-intervention.

Table 4.2. Means for middle-leader pedagogical content knowledge about SRL

Participant ID	Mean			Change score	
	Week 0 (n = 15)	Week 12 (n = 11)	Week 52 (n = 6)	Week 12 minus Week 0	Week 52 minus Week 0
ML1	2.00	3.50	2.17	1.50	0.17

ML2	3.33	3.33	3.83	0.00	0.50
ML3	1.33	NR	-	NR	-
ML4	1.00	2.83	NE	1.83	NE
ML5	2.17	1.67	NR	-0.50	NR
ML6	1.33	1.33	A	0.00	A
ML7	NR	2.00	1.33	NR	NR
ML8	2.33	NR	2.50	NR	0.17
ML9	-	3.17	4.00	-	-
ML10	2.17	-	-	-	-
ML11	1.00	NR	A	NR	A
ML12	NR	1.00	-	NR	-
ML13	1.83	-	-	-	-
ML14	NR	W	W	W	W
ML15	2.00	-	-	-	-
ML16	1.17	-	NE	-	NE
Total change				2.83	0.84
Mean change				0.57	0.28

'-' = Questionnaire not completed, NR = Questionnaire completed with no response, NE = No longer employed on site, A = Absent – on leave, W = Withdrawn

Table 4.2 shows that prior to the PLC-ER about SRL at Week 0, the quality of middle-leaders' pedagogical content knowledge about SRL was also generally low. For example, some middle-leaders out rightly expressed not knowing (e.g., ML4 wrote "[I'm] unsure how to do this" and ML11 wrote "I am unsure"). Other middle-leaders either wrote "surface-level" text segments about developing students' SRL knowledge (e.g., ML16 stated "through specific tasks", ML6 stated "implement into weekly scopes") or text segments that briefly mentioned explicitly teaching SRL strategies (e.g., ML1 stated "explicit teaching to introduce process and strategies", ML2 stated "students need to be explicitly taught strategies"). Immediately after the PLC-ER about SRL at Week 12, middle-leaders demonstrated variability in the change of the quality of their pedagogical content knowledge about SRL. For example, ML1 and ML4 demonstrated improvements in the quality of their knowledge (e.g., ML1 incorporated the role of strategy instruction by responding "[teach] one strategy at a time, then multiple times to embed the strategy…students need time to practice strategies"), while ML2 and ML6 showed no change, and ML5 reporting a decline in the quality of their knowledge. Nine months after the PLC-ER about SRL at Week 52, the remaining participating middle-leaders demonstrated growth in their pedagogical content knowledge about SRL. Further examples of the middle-leaders' responses coded against each quality dimension (e.g., extent, well-foundedness) can be found in Appendix R.

Statistical measures were not conducted with middle-leaders' pedagogical content knowledge scores at Week 0 to Week 12 due to low response rates to pedagogical content knowledge question items, and at Week 0 to Week 52 due to low sample sizes caused by participant attrition.

Whereas Table 4.2 reported changes in individual middle-leaders' mean quality scores over time, Figure 4.2 provides an alternative view to consider the nuanced changes between the six quality dimensions of pedagogical content knowledge about SRL (e.g., extent, well-foundedness) that appear in the quality of knowledge rubric.

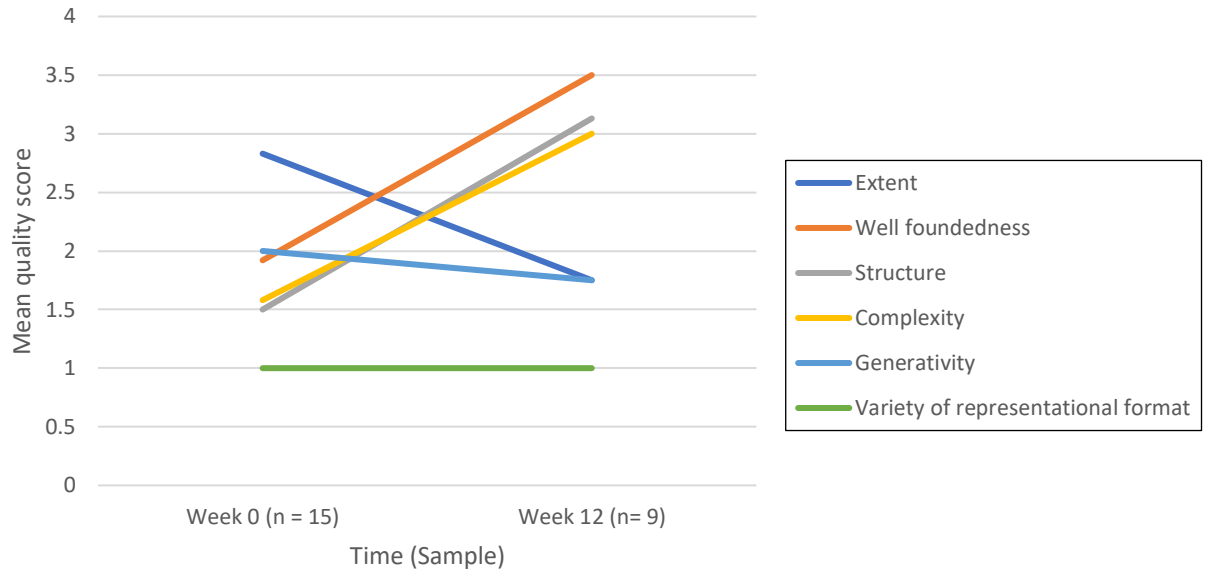

Figure 4.2. Means for quality dimensions of middle-leader pedagogical content knowledge

Figure 4.2 demonstrates that prior to the PLC-ER at Week 0, middle-leaders pedagogical content knowledge was similar in quality to their content knowledge about SRL, in that they made a substantial number of statements representing pedagogical content knowledge about SRL (i.e., extent), but this knowledge was relatively low on the other quality dimensions. Typically, middle-leaders made surface-level statements related to explicitly teaching SRL strategies, such as "through specific tasks" (ML16) and "implement into weekly scopes" (ML6). They also made statements that briefly mentioned explicitly teaching SRL strategies such as "explicit teaching to introduce process and strategies" (ML1) and "students need to be explicitly taught strategies" (ML2). In terms of assessing students' SRL, middle-leaders reported observing students' behaviour, such as "observation [was the best way to assess student SRL]" (ML3), and "tracking progress via observing" (ML13) but with no explanation of what such tracked progress would look like and "[observation of] students" ability to reflect on their learning" (ML16). My use of the quality of knowledge rubric (refer Table 3.15) evaluated these types of statements as being relatively impoverished, as they did not also include, for example, specific explanations of how the observations were conducted and recorded, how such

observations themselves evaluated the quality of students' behaviour, or what teaching actions were generated.

Interestingly, Figure 4.2 demonstrates that after the PLC-ER about SRL at Week 12, middle-leaders recorded fewer statements, but those statements were of higher quality, particularly for the dimensions of well-foundedness, structure and complexity. For example, ML1 elaborated the role of strategy instruction by responding "[teach] one strategy at a time, then multiple times to embed the strategy…students need time to practice strategies" while other middle-leaders acknowledged the benefit of using an evaluation sheet to assess students' SRL, such as the SRL Process Protocol (described earlier in section 3.7.7).

4.2. Changes in Middle-Leader Epistemic Beliefs

As described in the Method chapter, changes in middle-leaders' epistemic beliefs about SRL (source of SRL, SRL as an innate ability and structure of SRL) were measured using responses to five TEC-SRL questionnaire closed-ended items, as detailed in the following sections.

4.2.1. Changes in beliefs about source of SRL knowledge

Middle-leaders' beliefs about the source of SRL were measured using Likert scale (1-7, 1 = Very untrue; 7 = Very true) responses to two TEC-SRL items:

- **Item 4:** Knowledge of how to self-regulate learning comes from the teacher.
- **Item 5:** Knowledge of how to self-regulate learning comes from a student's own personal construction.

Middle-leader Likert-scale response scores to TEC-SRL Item 4 are reported in Table 4.3. These response scores were taken at: pre-intervention, immediate post-intervention and long-term post-intervention, difference between pre-intervention and immediate post-intervention and difference between pre-intervention and long-term post-intervention.

Table 4.3. Middle-leader Likert-scale responses for Item 4

Participant ID	Likert-scale response score (1 = Very untrue to 7 = Very true)			Change score	
	Week 0 (n = 15)	Week 12 (n = 11)	Week 52 (n = 6)	Week 12 minus Week 0	Week 52 minus Week 0
ML1	6.00	6.00	6.00	0.00	0.00
ML2	6.00	7.00	7.00	1.00	1.00
ML3	5.00	6.00	-	1.00	-
ML4	5.00	6.00	NE	1.00	NE
ML5	5.00	5.00	5.00	0.00	0.00
ML6	5.00	4.00	A	-1.00	A
ML7	5.00	7.00	6.00	2.00	1.00

ML8	6.00	5.00	5.00	-1.00	-1.00
ML9	-	5.00	5.00	-	-
ML10	5.00	-	-	-	-
ML11	5.00	5.00	A	0.00	A
ML12	4.00	4.00	-	0.00	-
ML13	6.00	-	-	-	-
ML14	5.00	W	W	W	W
ML15	7.00	-	-	-	-
ML16	5.00	-	NE	-	NE
Total change				3.00	1.00
Mean change				0.3	0.2

'-' = Not completed, NE = No longer employed on site, A = Absent – on leave, W = Withdrawn

Table 4.3 shows that prior to the PLC-ER about SRL at Week 0, 14 of the 15 middle-leaders who completed the pre-intervention TEC-SRL questionnaire (93%) scored 5 or higher, which indicates a belief that knowledge of how to self-regulate comes from the teacher. Immediately after the PLC-ER about SRL at Week 12, nine of the 11 middle-leaders who completed the immediate post-intervention TEC-SRL questionnaire (82%) scored 5 or higher, which indicates a belief that knowledge of how to self-regulate comes from the teacher. Four of the ten who completed both pre-intervention and immediate post-intervention questionnaires showed increases, while two showed decreases, with an overall *increase* of change (mean change 0.30). Nine months after the PLC-ER about SRL at Week 52, all middle-leaders who completed the long-term post-intervention TEC-SRL questionnaire (100%) scored 5 or higher, which indicates a belief that knowledge of how to self-regulate comes from the teacher. Two of the five who completed both pre-intervention and long-term post-intervention questionnaires showed increases, while one showed decrease, with an overall *increase* in change (mean change 0.20).

A non-parametric Wilcoxon Signed-Ranks Tests was calculated on matched middle-leaders' (n=10) Likert-scale scores for Item 4 and indicated an *increase* in middle-leaders' belief that SRL knowledge comes from the teacher from Week 0 (*Median* = 5.00) to Week 12 (*Median* = 5.50). This result was *not statistically significant*, z = -1.000, p = 0.317. Statistical measures were not conducted with Week 52 scores due to low sample sizes caused by participant attrition.

Middle-leaders' Likert-scale response scores to TEC-SRL Item 5 are reported in Table 4.4. These response scores were taken at: pre-intervention, immediate post-intervention and long-term post-intervention, difference between pre-intervention and immediate post-intervention and difference between pre-intervention and long-term post-intervention.

Table 4.4. Middle-leader Likert-scale responses for Item 5

Participant ID	Likert-scale response score (1 = Very untrue to 7 = Very true)			Change score	
	Week 0 (n = 15)	Week 12 (n = 11)	Week 52 (n = 6)	Week 12 minus Week 0	Week 52 minus Week 0
ML1	3.00	5.00	5.00	2.00	2.00
ML2	3.00	2.00	2.00	-1.00	-1.00
ML3	7.00	6.00	-	-1.00	-
ML4	6.00	6.00	NE	0.00	NE
ML5	5.00	5.00	5.00	0.00	0.00
ML6	5.00	5.00	A	0.00	A.00
ML7	5.00	6.00	6.00	1.00	1.00
ML8	6.00	7.00	5.00	1.00	-1.00
ML9	-	7.00	5.00	-	-
ML10	5.00	-	-	-	-
ML11	5.00	3.00	A	-2.00	A
ML12	4.00	5.00	-	1.00	-
ML13	6.00	-	-	-	-
ML14	5.00	W	W	W	W
ML15	7.00	-	-	-	-
ML16	5.00	-	NE	-	NE
Total change				1.00	1.00
Mean change				0.10	0.20

'-' = Not completed, NE = No longer employed on site, A = Absent – on leave, W = Withdrawn

Table 4.4 shows that prior to the PLC-ER about SRL at Week 0, 12 of the 15 middle-leaders who completed the pre-intervention TEC-SRL questionnaire (80%) scored 5 or higher, indicating a belief that knowledge of how to self-regulate learning comes from a student's own personal construction. Immediately after the PLC-ER about SRL at Week 12, nine of the 11 middle-leaders who completed the immediate post-intervention TEC-SRL questionnaire (82%) scored 5 or higher, indicating a belief that knowledge of how to self-regulate learning comes from a student's own personal construction. Four of the ten who completed both pre-intervention and immediate post-intervention questionnaires showed increases, while three showed decreases, with an overall *increase* of change (mean change 0.10). Nine months after the PLC-ER about SRL at Week 52, five of the six middle-leaders who completed the long-term post-intervention TEC-SRL questionnaire (83%) scored 5 or higher, which indicates a belief that knowledge of how to self-regulate learning comes from a student's own personal construction. Two of the five who completed both pre-intervention and long-term

post-intervention questionnaires showed increases, while two showed decreases, with an overall *increase* in change (mean change 0.20).

A non-parametric Wilcoxon Signed-Ranks Tests was calculated on matched middle-leaders' (n=10) Likert-scale scores for Item 5 and indicated *no change* from Week 0 to Week 12. Statistical measures were not conducted with Week 52 scores due to low sample sizes caused by participant attrition.

Taken together, Table 4.3 and Table 4.4 demonstrate that prior to the PLC-ER, middle-leaders believed that students' knowledge about SRL was sourced both from their teachers and from the students' personal construction. This finding reflects the argument that epistemic beliefs might not exist in isolated classifications (Buehl & Fives, 2009; Olafson & Schraw, 2006). For example, it is not a case of SRL knowledge being sourced from the teacher *or* the student, but rather SRL knowledge being sources from the teacher *and* the student. In addition, immediately after the PLC-ER about SRL at Week 12, middle-leaders' beliefs about the source of SRL knowledge only slightly changed, indicating that middle-leaders' generally maintained their beliefs about the dual source of SRL knowledge.

4.2.2. Changes in beliefs about SRL knowledge as innate ability

Changes in middle-leaders' beliefs about SRL knowledge as innate ability were measured using their Likert scale (1-7, 1 = Very untrue; 7 = Very true) responses to two TEC-SRL questionnaire items:

- **Item 6:** SRL is a talent students are born with.
- **Item 7:** Students can learn how to be effective self-regulated learners.

Middle-leaders' Likert-scale response scores to TEC-SRL Item 6 are reported in Table 4.5. These response scores were taken at: pre-intervention, immediate post-intervention and long-term post-intervention, difference between pre-intervention and immediate post-intervention and difference between pre-intervention and long-term post-intervention.

Table 4.5. Middle-leader Likert-scale responses for Item 6

Participant ID	Likert-scale response score (1 = Very untrue to 7 = Very true)			Change score	
	Week 0 (n = 15)	Week 12 (n = 11)	Week 52 (n = 6)	Week 12 minus Week 0	Week 52 minus Week 0
ML1	2.00	3.00	2.00	1.00	0.00
ML2	1.00	2.00	1.00	1.00	0.00
ML3	5.00	2.00	-	-3.00	-
ML4	3.00	5.00	NE	2.00	NE
ML5	3.00	2.00	3.00	-1.00	0.00

ML6	1.00	2.00	A	1.00	A
ML7	1.00	2.00	2.00	1.00	1.00
ML8	3.00	5.00	4.00	2.00	1.00
ML9	-	1.00	1.00	-	-
ML10	1.00	-	-	-	-
ML11	2.00	2.00	A	0.00	A
ML12	4.00	4.00	-	0.00	-
ML13	4.00	-	-	-	-
ML14	4.00	W	W	W	W
ML15	5.00	-	-	-	-
ML16	3.00	-	NE	-	NE
Total change				4.00	2.00
Mean change				0.40	0.40

'-' = Not completed, NE = No longer employed on site, A = Absent – on leave, W = Withdrawn

Table 4.5 shows that prior to the PLC-ER about SRL at Week 0, 10 of the 15 middle-leaders who completed the pre-intervention TEC-SRL questionnaire (67%) scored 3 or lower indicating a belief that SRL is *not* an innate ability. Immediately after the PLC-ER about SRL at Week 12, eight of the 11 middle-leaders who completed the immediate post-intervention TEC-SRL questionnaire (73%) scored 3 or lower, indicating a belief that SRL is *not* an innate ability. Six of the ten who completed both pre-intervention and immediate post-intervention questionnaires showed increases, while two showed decreases, with an overall *increase* of change (mean change 0.40). Nine months after the PLC-ER about SRL at Week 52, five of the six middle-leaders who completed the long-term post-intervention TEC-SRL questionnaire (83%) scored 3 or lower, which indicates a belief that SRL is *not* innate ability. Two of the five who completed both pre-intervention and long-term post-intervention questionnaires showed increases, while three showed no change, with an overall *increase* in the strength of this belief (mean change 0.40).

A non-parametric Wilcoxon Signed-Ranks Tests was calculated on matched middle-leaders' (n=10) Likert-scale scores for Item 6 and indicated a *decrease* in middle-leaders' belief that SRL *is* a talent students are born with from Week 0 (*Median* = 3.00) to Week 12 (*Median* = 2.00). In other words, an increase in middle-leaders' belief that SRL is *not* an innate ability, which is consistent with my interpretation of results reported in Table 4.5. This result was *not statistically significant*, z = -1.006, p = 0.314. Statistical measures were not conducted with Week 52 scores due to low sample sizes caused by participant attrition.

Following from Table 4.5, middle-leaders' Likert-scale response scores to TEC-SRL Item 7 are reported in Table 4.6. These response scores were taken at: pre-intervention, immediate

post-intervention and long-term post-intervention, difference between pre-intervention and immediate post-intervention and difference between pre-intervention and long-term post-intervention.

Table 4.6. Middle-leader Likert-scale responses for Item 7

Participant ID	Likert-scale response score (1 = Very untrue to 7 = Very true)			Change score	
	Week 0 (n = 15)	Week 12 (n = 11)	Week 52 (n = 6)	Week 12 minus Week 0	Week 52 minus Week 0
ML1	6.00	7.00	6.00	1.00	0.00
ML2	6.00	7.00	7.00	1.00	1.00
ML3	7.00	7.00	-	0.00	-
ML4	6.00	7.00	NE	1.00	NE
ML5	6.00	7.00	6.00	1.00	0.00
ML6	7.00	6.00	A	-1.00	A
ML7	7.00	7.00	7.00	0.00	0.00
ML8	7.00	7.00	6.00	0.00	-1.00
ML9	-	7.00	7.00	-	-
ML10	6.00	-	-	-	-
ML11	6.00	6.00	A	0.00	A
ML12	5.00	5.00	-	0.00	-
ML13	6.00	-	-	-	-
ML14	7.00	W	W	W	W
ML15	7.00	-	-	-	-
ML16	6.00	-	NE	-	NE
Total change				3.00	0.00
Mean change				0.30	0.00

'-' = Not completed, NE = No longer employed on site, A = Absent – on leave, W = Withdrawn

Table 4.6 shows that prior to the PLC-ER about SRL at Week 0, all the 15 middle-leaders who completed the pre-intervention TEC-SRL questionnaire (100%) scored 5 or higher, which indicates a belief that students can learn how to self-regulate their learning. Immediately after the PLC-ER about SRL at Week 12, and again 9-months after the PLC-ER about SRL at Week 52, all the remaining participating middle-leaders who completed the immediate and long-term post-intervention TEC-SRL questionnaire (100%) scored 5 or higher, which indicates a belief that students can learn how to self-regulate their learning. One of the five who completed both pre-intervention and long-term post-intervention questionnaires showed increase, while one showed decrease, with an overall result of *no change* (mean change 0.00).

A non-parametric Wilcoxon Signed-Ranks Tests was calculated on matched middle-leaders' (n=10) Likert-scale scores for Item 7 and indicated an *increase* in middle-leaders' belief that students can learn to self-regulate their learning from Week 0 (*Median* = 6.00) to Week 12 (*Median* = 7.00). However, this result was *not statistically significant*, z = -1.342, p = 0.180. Statistical measures were not conducted with Week 52 scores due to low sample sizes caused by participant attrition.

Table 4.5 and Table 4.6 demonstrate that prior to the PLC-ER about SRL at Week 0, middle-leaders typically believed that students' knowledge about SRL was *not* an innate ability but learned. This belief was relatively consistent immediately after the PLC-ER at Week 12, and then again 9-months after the PLC-ER at Week 52. This is a positive finding as the teachers' epistemic belief that students can learn how to be effective self-regulated learners is associated with teachers fostering students' knowledge of SRL strategies in the classroom (Dignath-van Ewijk, 2016; Vosniadou et al., 2020). However, a closer analysis of the individual middle-leaders' responses revealed that some middle-leaders actually demonstrated a dual-belief system (that SRL knowledge is a combination of innate ability and learning). For example, ML3 and ML15 agreed with both Likert scale Items 6 and 7. Meanwhile, ML4 and ML8 progressed toward a dual belief over the duration of the PLC-ER about SRL. This is an expected result (given the focus of the PLC-ER about SRL) and conversations related to the explicit teaching of SRL strategies that all supported the belief that SRL can be learnt.

4.2.3. Changes in beliefs about structure of SRL knowledge

Changes in middle-leaders' beliefs about the structure of SRL knowledge was measured using Likert scale (1-7, 1 = Very untrue; 7 = Very true) responses to one TEC-SRL item:

- **Item 8:** Knowledge of SRL is equal in complexity to other subjects (e.g., Maths).

Middle-leaders' Likert-scale response scores to Item 8 are reported in Table 4.7. These response scores were taken at: pre-intervention, immediate post-intervention and long-term post-intervention, difference between pre-intervention and immediate post-intervention and difference between pre-intervention and long-term post-intervention.

Table 4.7. Middle-leader Likert-scale responses for Item 8

Participant ID	Likert-scale response score (1 = Very untrue to 7 = Very true)			Change score	
	Week 0 (n = 15)	Week 12 (n = 11)	Week 52 (n = 6)	Week 12 minus Week 0	Week 52 minus Week 0
ML1	6.00	6.00	6.00	0.00	0.00
ML2	6.00	7.00	6.00	1.00	0.00
ML3	7.00	7.00	-	0.00	-
ML4	6.00	6.00	NE	0.00	NE
ML5	6.00	7.00	6.00	1.00	0.00

ML6	6.00	6.00	A	0.00	A
ML7	3.00	7.00	5.00	4.00	2.00
ML8	7.00	6.00	6.00	-1.00	-1.00
ML9	-	6.00	5.00	-	-
ML10	3.00	-	-	-	-
ML11	4.00	5.00	A	1.00	A
ML12	4.00	4.00	-	0.00	-
ML13	4.00	-	-	-	-
ML14	5.00	W	W	W	W
ML15	4.00	-	-	-	-
ML16	7.00	-	NE	-	NE
Total change				6.00	1.00
Mean change				0.60	0.20

'-' = Not completed, NE = No longer employed on site, A = Absent – on leave, W = Withdrawn

Table 4.7 shows that prior to the PLC-ER about SRL at Week 0, nine of the 15 middle-leaders who completed the pre-intervention TEC-SRL questionnaire (60%) scored 5 or higher, which indicates a belief that the structure of SRL knowledge was equal in complexity to other subjects. Immediately after the PLC-ER about SRL at Week 12, 10 of the 11 middle-leaders who completed the immediate post-intervention TEC-SRL questionnaire (91%) scored 5 or higher, which indicates a belief that SRL knowledge was equal in complexity to other subjects. Four of the ten who completed both pre-intervention and immediate post-intervention questionnaires showed increases (one substantial), while one showed decrease, with an overall *increase* of change (mean change 0.60). Nine months after the PLC-ER about SRL at Week 52, all the six middle-leaders who completed the long-term post-intervention TEC-SRL questionnaire (100%) scored 5 or higher, which indicates a belief that SRL knowledge was complex. One of the five who completed both pre-intervention and long-term post-intervention questionnaires showed increase, while one showed decrease, with an overall *increase* in change (mean change 0.20).

A non-parametric Wilcoxon Signed-Ranks Tests was calculated on matched middle-leaders' (n=10) Likert-scale response scores for Item 8 and indicated *no change* from Week 0 to Week 12. Statistical measures were not conducted with Week 52 scores due to low sample sizes caused by participant attrition.

As stated at 2.3.2, researchers have demonstrated that teachers who believe knowledge is simple engage in less productive learning behaviours (Ravindran et al., 2005), while those that believe knowledge is complex engage in more productive learning behaviours (Bondy et al., 2007). Therefore, middle-leaders who believed SRL knowledge is complex, are more likely to engage in high-quality epistemic cognition about SRL (or epistemic cognition that aligns with SRL theory), and therefore, SRL teaching initiatives in the classroom.

4.3. Changes in Middle-Leader Epistemic Value

Changes in middle-leaders' epistemic value about SRL was measured using Likert scale (1-7, 1 = Very untrue; 7 = Very true) responses to four TEC-SRL items:

- **Item 9:** When planning a regular lesson, I explicitly set a teaching goal to develop students' knowledge about SRL.
- **Item 10:** It is important to develop students' knowledge about SRL.
- **Item 11:** When planning a regular lesson, I explicitly set a teaching goal to assess students' knowledge about SRL.
- **Item 12:** It is important to assess students' knowledge about SRL.

Mean scores for these four items are reported in Table 4.8. These means include: pre-intervention, immediate post-intervention and long-term post-intervention, difference between pre-intervention and immediate post-intervention and difference between pre-intervention and long-term post-intervention.

Table 4.8. Means for middle-leader Likert-scale response scores for Items 9-12

Participant ID	Mean			Change score	
	Week 0 (n = 15)	Week 12 (n = 11)	Week 52 (n = 6)	Week 12 minus Week 0	Week 52 minus Week 0
ML1	5.00	6.00	6.00	1.00	1.00
ML2	4.00	6.25	6.25	2.25	2.25
ML3	5.00	6.75	-	1.75	-
ML4	3.50	5.50	NE	2.00	NE
ML5	3.50	5.50	3.25	2.00	-0.25
ML6	4.25	4.50	A	0.25	A
ML7	5.00	7.00	4.75	2.00	-0.25
ML8	4.75	5.00	3.75	0.25	-1.00
ML9	-	6.00	5.75	-	-
ML10	3.00	-	-	-	-
ML11	3.50	3.50	A	0.00	A
ML12	4.25	4.50	-	0.25	-
ML13	4.25	-	-	-	-
ML14	6.00	W	W	W	W
ML15	5.50	-	-	-	-
ML16	6.00	-	NE	-	NE
Total change				11.75	1.75
Mean change				1.18	0.35

'-' = Not completed, NE = No longer employed on site, A = Absent – on leave, W = Withdrawn

Table 4.8 shows that prior to the PLC-ER about SRL at Week 0, eight of the 15 middle-leaders who completed the pre-intervention TEC-SRL questionnaire (53%) scored 5 (including rounded to 5) or higher, which indicates epistemic value for teaching SRL. Immediately after the PLC-ER about SRL at Week 12, 10 of the 11 middle-leaders who completed the immediate post-intervention TEC-SRL questionnaire (91%) scored 5 (including rounded to 5) or higher, which indicates epistemic value for teaching SRL knowledge. Six of the ten who completed both pre-intervention and immediate post-intervention questionnaires showed increases (not including 0.25 change scores), with an overall *increase* of change (mean change 1.18). Nine months after the PLC-ER about SRL at Week 52, four of the six middle-leaders who completed the long-term post-intervention TEC-SRL questionnaire (67%) scored 5 (including rounded to 5) or higher, which indicates epistemic value for teaching SRL. Two of the five who completed both pre-intervention and long-term post-intervention questionnaires showed increases, while three showed decreases, with an overall *increase* in change (mean change 0.35).

A non-parametric Wilcoxon Signed-Ranks Tests was calculated on matched middle-leaders' (n=10) mean scores for epistemic value and indicated an *increase* from Week 0 (*Median* = 4.25) to Week 12 (*Median* = 5.50). This result was *statistically significant*, z = -2.684, p = 0.007 and it showed a large effect size of *r* = -0.53. Statistical measures were not conducted with Week 52 scores due to low sample sizes caused by participant attrition.

Table 4.8 reported middle-leader mean scores for epistemic values for Items 9 through 12. To consider more nuanced changes between items, Table 4.9 reports means and standard deviations of middle-leaders' Likert-scale response scores for Items 9 through 12. These values are calculated at: pre-intervention and immediate post-intervention, plus the difference between these.

Table 4.9. Means for middle-leader Likert-scale responses for Items 9-12

	Mean (SD)		**Change score**
Item	**Week 0 (n = 15)**	**Week 12 (n = 11)**	**Week 12 minus Week 0**
9: When planning a regular lesson, I explicitly set a teaching goal to develop students' knowledge about SRL	4.20 (1.52)	5.45 (1.44)	1.25
10: It is important to develop students' knowledge about SRL	5.87 (0.92)	6.36 (0.67)	0.49
11: When planning a regular lesson, I explicitly set a teaching goal to assess students' knowledge about SRL	3.53 (1.51)	4.64 (1.75)	1.11
12: It is important to assess students' knowledge about SRL	4.40 (1.30)	5.55 (1.29)	1.15

Table 4.9 shows that prior to the PLC-ER about SRL at Week 0, middle-leaders' epistemic value for *developing* students' knowledge about SRL (TEC-SRL Item 10) was high, with no

response lower than 5 (somewhat true). Immediately following the PLC-ER about SRL at Week 12, middle-leaders typically increased their epistemic value for *developing* students' knowledge about SRL or remained the same. At Week 0, middle-leaders' epistemic value for *assessing* students' SRL knowledge (TEC-SRL Item 12) showed greater variance, with responses ranging from 2 (Untrue) to 7 (Very true). However, immediately after the PLC-ER about SRL at Week 12, middle-leaders typically increased their epistemic value for assessing students' SRL knowledge.

Table 4.9 demonstrates that before the PLC-ER at Week 0, middle-leaders generally placed value on SRL knowledge. This finding corresponds with other studies that have indicated that teachers value SRL (Dignath & Büttner, 2018; Karlen et al., 2020). Teachers' epistemic value for SRL holds promise for SRL teaching initiatives in schools (De Smul et al., 2018; Dignath-van Ewijk & van der Werf, 2012). Interestingly, Table 4.9, demonstrates that prior to the PLC-ER, when comparing Item 10 and Item 12, middle-leaders placed greater value on *developing* students' knowledge about SRL than *assessing* students' knowledge about SRL. Yet, effective teaching requires an interplay between ongoing assessment and development of student knowledge (Grigorenko, 2009), so the difference in value is noteworthy. There are multiple explanations for the disparity in value. For example, middle-leaders may not view formative assessment as sufficient in response to the question item, they might be time-poor and focus on the curriculum content over general capabilities like SRL, or they may feel that they do not want to over-assess their students.

Immediately after the PLC-ER about SRL at Week 12, middle-leaders' scores indicated improvements in their epistemic value about SRL. Epistemic value about SRL is much broader than the Likert scale items. Epistemic value can also be inferred from middle-leaders' epistemic reflexivity for teaching about SRL, which I address in more depth in Chapter 5.

4.4. Changes in Middle-Leader Epistemic Ideals

Changes in middle-leaders' epistemic ideals about SRL were measured using Likert scale (1-7, 1 = Very untrue; 7 = Very true) responses to two TEC-SRL items:

- **Item 15:** I know when students have achieved deeper knowledge about SRL.
- **Item 17:** I use a set of criteria to evaluate whether students have achieved deeper knowledge about SRL.

Middle-leaders' Likert-scale response scores to TEC-SRL item 15 are reported in Table 4.10. These response scores were taken at: pre-intervention, immediate post-intervention and long-term post-intervention, difference between pre-intervention and immediate post-intervention and difference between pre-intervention and long-term post-intervention.

Table 4.10. Middle-leader Likert-scale responses for Item 15

Participant ID	Likert-scale response score (1 = Very untrue to 7 = Very true)			Change score	
	Week 0 (n = 15)	Week 12 (n = 11)	Week 52 (n = 6)	Week 12 minus Week 0	Week 52 minus Week 0
ML1	3.00	6.00	5.00	3.00	2.00
ML2	2.00	6.00	6.00	4.00	4.00
ML3	6.00	6.00	-	0.00	-
ML4	2.00	5.00	NE	3.00	NE
ML5	5.00	6.00	4.00	1.00	-1.00
ML6	4.00	4.00	-	0.00	A
ML7	3.00	6.00	5.00	3.00	2.00
ML8	6.00	6.00	5.00	0.00	-1.00
ML9	-	5.00	5.00	-	-
ML10	6.00	-	-	-	-
ML11	4.00	5.00	A	1.00	A
ML12	2.00	4.00	-	2.00	-
ML13	4.00	-	-	-	-
ML14	7.00	W	W	W	W
ML15	2.00	-	-	-	-
ML16	6.00	-	NE	-	NE
Total change				17.00	6.00
Mean change				1.70	1.20

'-' = Not completed, NE = No longer employed on site, A = Absent – on leave, W = Withdrawn

Table 4.10 shows that, prior to the PLC-ER about SRL at Week 0, six of the 15 middle-leaders who completed the pre-intervention TEC-SRL questionnaire (40%) scored 5 or higher, which indicates a belief that they knew when students had achieved a deeper knowledge about SRL. Immediately following the PLC-ER about SRL at Week 12, seven of the 11 middle-leaders who completed the immediate post-intervention TEC-SRL questionnaire (64%) scored 5 or higher, which indicates a belief that they knew when their students had achieved deeper knowledge about SRL. Seven of the ten who completed both pre-intervention and immediate post-intervention questionnaires showed substantial increases in the range of 1 through 4 points, with an overall *increase* of change (mean change 1.70). Nine months after the PLC-ER about SRL at Week 52, three of the five middle-leaders who completed the long-term post-intervention TEC-SRL questionnaire (60%) scored 5 or higher, which indicates a belief that they knew that their students had achieved deeper knowledge about SRL. Three of the five who completed both pre-intervention and long-term post-intervention questionnaires showed substantial increases in the range of 2 through 4 points, with an overall *increase* of change (mean change 1.20).

A non-parametric Wilcoxon Signed-Ranks Tests was calculated on matched middle-leaders' (n=10) Likert-scale scores for item 15 and indicated an *increase* from Week 0 (*Median* = 4.00) to Week 12 (*Median* = 6.00). This result was *statistically significant*, z = -2.388, p = 0.017 and it showed a medium effect size of *r* = -0.47. Statistical measures were not conducted with Week 52 scores due to low sample sizes caused by participant attrition.

Middle-leaders' Likert-scale response scores to Item 17 are reported in Table 4.11. These response scores were taken at: pre-intervention, immediate post-intervention and long-term post-intervention, difference between pre-intervention and immediate post-intervention and difference between pre-intervention and long-term post-intervention.

Table 4.11. Middle-leader Likert-scale responses for Item 17

Participant ID	Likert-scale response score (1 = Very untrue to 7 = Very true)			Change score	
	Week 0 (n = 15)	Week 12 (n = 11)	Week 52 (n = 6)	Week 12 minus Week 0	Week 52 minus Week 0
ML1	2.00	5.00	6.00	3.00	4.00
ML2	2.00	6.00	5.00	4.00	3.00
ML3	2.00	5.00	-	3.00	-
ML4	1.00	3.00	NE	2.00	NE
ML5	1.00	2.00	3.00	1.00	2.00
ML6	1.00	2.00	A	1.00	A
ML7	5.00	6.00	5.00	1.00	0.00
ML8	4.00	4.00	2.00	0.00	-2.00
ML9	-	2.00	6.00	-	-
ML10	2.00	-	-	-	-
ML11	4.00	3.00	A	-1.00	A
ML12	2.00	3.00	-	1.00	-
ML13	3.00	-	-	-	-
ML14	7.00	W	W	W	W
ML15	2.00	-	-	-	-
ML16	6.00	-	NE	-	NE
Total change				15.00	7.00
Mean change				1.50	1.40

'-' = Not completed, NE = No longer employed on site, A = Absent – on leave, W = Withdrawn

Table 4.11 shows that prior to the PLC-ER about SRL at Week 0, only three of the 15 middle-leaders who completed the TEC-SRL questionnaires (20%) scored 5 or higher indicating that they used epistemic ideals to assess students' SRL. Immediately after the PLC-ER about SRL at Week 12, only four of the 11 middle-leaders who completed the immediate post-intervention TEC-SRL questionnaire (36%) scored 5 or higher indicating that they used epistemic ideals to assess students' SRL. Eight of the ten who completed both pre-

intervention and immediate post-intervention questionnaires showed increases ranging between 1 and 4 points, while one showed decrease, with an overall *increase* of change (mean change 1.50). This is an interesting finding when combined with the results from Item 15 in Table 4.10, in which 64% of middle-leaders reported (with scores of 5 or more) a better sense of "epistemic knowing" when their students had achieved a deeper knowledge about SRL. In other words, their epistemic knowing grew, but the quality of their epistemic ideals did not, begging the question – on what basis did their "knowing" change? Nine months after the PLC-ER about SRL at Week 52, four of the six middle-leaders who completed the long-term post-intervention TEC-SRL questionnaire (67%) indicated using epistemic ideals to assess students' SRL. Three of the five who completed both pre-intervention and long-term post-intervention questionnaires showed increases, while one showed decrease, with an overall *increase* in change (mean change 1.40).

A non-parametric Wilcoxon Signed-Ranks Tests was calculated on matched middle-leaders' (n=10) Likert-scale scores for item 17 and indicated an *increase* from Week 0 (*Median* = 2.00) to Week 12 (*Median* = 3.00). This result was *statistically significant*, z = -2.354, p = 0.019 and it showed a medium effect size of *r* = -0.46. Statistical measures were not conducted with Week 52 scores due to low sample sizes caused by participant attrition.

Changes in middle-leaders' epistemic ideals about SRL were also measured using the quality analysis rubric (see section 3.8.1, specifically Table 3.15) to evaluate their responses to two TEC-SRL open-ended items:

- **Item 16.** How do you know if students have achieved deeper knowledge about SRL?
- **Item 18.** If so, what criteria do you use?

Means for middle-leader quality of epistemic ideals about SRL are reported in Table 4.12. These response scores were taken at: pre-intervention, immediate post-intervention and long-term post-intervention, difference between pre-intervention and immediate post-intervention and difference between pre-intervention and long-term post-intervention.

Table 4.12. Means for middle-leader quality scores of epistemic ideals about SRL

Participant ID	Mean			Change score	
	Week 0 (n = 15)	Week 12 (n = 11)	Week 52 (n = 6)	Week 12 minus Week 0	Week 52 minus Week 0
ML1	1.33	2.00	2.00	0.67	0.67
ML2	2.00	2.83	3.17	0.83	1.17
ML3	1.83	NR	-	NR	-
ML4	1.00	2.50	NE	1.50	NE
ML5	1.67	1.00	NR	-0.67	NR
ML6	1.17	NR	A	NR	A

ML7	1.00	2.00	2.33	1.00	1.33
ML8	2.83	1.00	3.00	-1.83	0.17
ML9	-	2.33	3.00	-	-
ML10	1.00	-	-	-	-
ML11	NR	NR	A	NR	A
ML12	1.00	1.00	-	NR	-
ML13	NR	-	-	-	-
ML14	2.67	W	W	W	W
ML15	NR	-	-	-	-
ML16	1.83	-	NE	-	NE
Total change				1.50	3.34
Mean change				0.25	0.84

'-' = Questionnaire not completed, NR = Questionnaire completed with no response, NE = No longer employed on site, A = Absent – on leave, W = Withdrawn

Table 4.12 shows that prior to the PLC-ER about SRL at Week 0, the quality of middle-leaders' epistemic ideals was low in quality. Immediately after the PLC-ER about SRL at Week 12, the quality of middle-leaders' epistemic ideals varied substantially at the individual level. Four of the six who provided responses both pre-intervention and immediate post-intervention questionnaires showed increases, while two showed decreases, with an overall *increase* of change (mean change 0.25). Nine months after the PLC-ER about SRL at Week 52, the remaining five middle-leaders who responded to items 16 and 18 continued to improve the quality of their epistemic ideals. Three of the four middle-leaders who responded to items 16 and 18 on both pre-intervention and long-term post-intervention questionnaires showed increases, with an overall *increase* in change (mean change 0.84).

While several participants responded to Item 16, at Item 18 (asked for the criteria they used) only one middle-leader responded prior to the PLC-ER about SRL and only two responded after the PLC-ER about SRL. These few responses to Item 18 referred to criteria to be used in assessment tasks (e.g., "criteria for assessment depending on the task", "looking at different areas of assessment"), but added little of value to identification of middle-leaders' epistemic ideals about SRL.

A non-parametric Wilcoxon Signed-Ranks Tests was calculated on matched middle-leaders' (n=7) mean quality scores for epistemic ideals and indicated an increase from Week 0 (*Median* = 3.50) to Week 12 (*Median* = 4.00). This result was *not statistically significant*, z = -0.631, p = 0.528. Statistical measures were not conducted with Week 52 scores due to low sample sizes caused by participant attrition.

Whereas Table 4.12 reported changes in individual middle-leaders' mean quality scores over time, Figure 4.3 provides an alternative view to consider the nuanced changes between

the six quality dimensions (e.g., extent, well-foundedness) that appear in the quality of knowledge rubric.

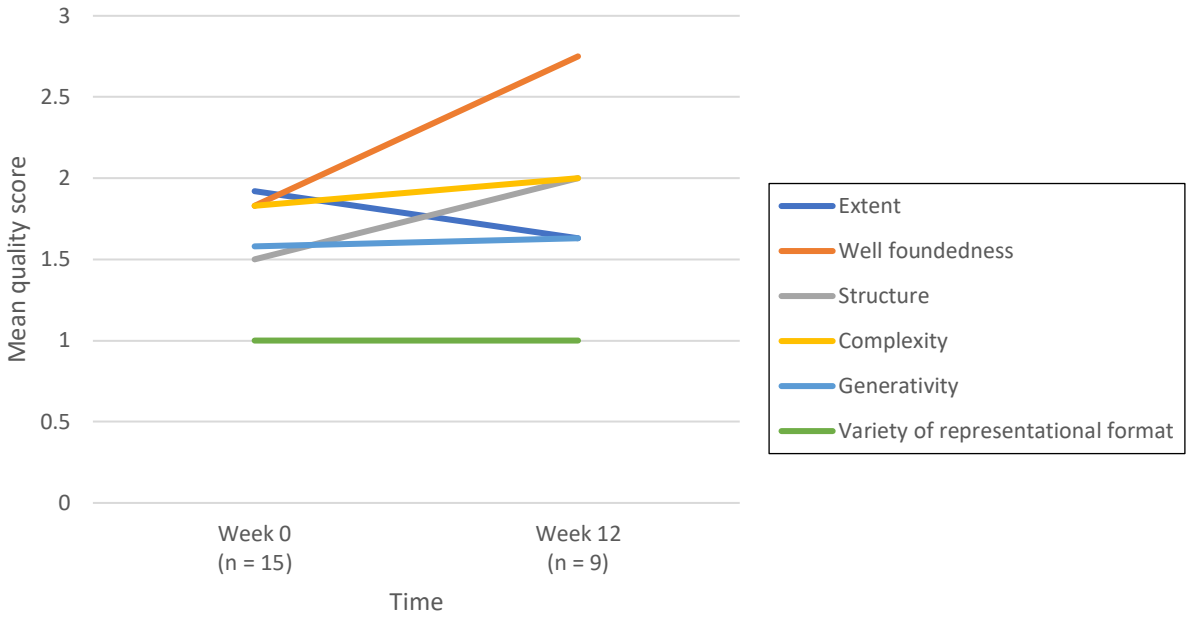

Figure 4.3. Means for quality dimensions of middle-leader epistemic ideals

Figure 4.3 demonstrates that prior to the PLC-ER at Week 0, middle-leaders possessed low-quality epistemic ideals about SRL (i.e., quality scores were lower than two for all quality dimensions). Following the PLC-ER at Week 12, middle-leaders generally demonstrated variable change, but substantial growth was noted in the dimension of *well-foundedness*. This suggests that as middle-leaders engaged in a PLC-ER about SRL, their epistemic ideals about SRL achieved greater alignment with the current literature about SRL. This finding is not surprising given the improvement in middle-leaders' knowledge about SRL noted earlier in Section 4.1. However, a decrease in the number of text segments coded (*extent*) decreased, while *generativity* and *variety of representational format* continued with no real change. These three quality dimensions (*extent, generativity, variety of representational format)* may be inherently related as this was a similar pattern noted about the quality of middle-leaders' pedagogical content knowledge about SRL earlier in Section 4.1.2.

Results revealed that, prior to participation in the PLC-ER about SRL, the quality of middle-leaders' epistemic ideals about SRL was relatively low. For example, participating middle-leaders commonly reported observable (but vague) student behaviours ("student is on-task") or reported on the quality of student work (higher quality work output meant higher quality SRL) as their epistemic ideals for evaluating students' SRL knowledge. Examples of middle-leaders' responses coded against each quality dimension (e.g., extent, well-foundedness) can be found in the Coding Manual in Appendix O.

My use of the quality of knowledge rubric (refer Table 3.15) evaluated middle-leaders' statements about epistemic ideals as being relatively impoverished, as they did not include, for example, specific explanations of the criteria that they used to evaluate students' SRL knowledge. This finding (i.e., low quality epistemic ideals) is consistent with Callan and Shim (2019) who reported that, when identifying students who are engaged in SRL, teachers refer to observation of "maladaptive classroom behaviours and/or outcomes (e.g., off task, poor work completion)" (p. 295) rather than more high quality epistemic ideals (e.g., observation of self-monitoring strategies).

4.5. Changes in Middle-Leader Metacognitive Regulation

Middle-leaders' metacognitive regulation of their epistemic cognition for teaching about SRL was measured using Likert scale (1-7, 1 = Very untrue; 7 = Very true) responses to 12 TEC-SRL items:

- **Item 19:** I pace myself while I am teaching about SRL in order to have enough time.
- **Item 20:** I ask myself periodically if I meet my teaching goals about SRL while I am teaching.
- **Item 21:** I ask myself how well I have accomplished my teaching goals about SRL once I am finished
- **Item 22:** I set my specific teaching goals about SRL before I start teaching
- **Item 23:** I find myself assessing how useful my teaching techniques for SRL are while I am teaching.
- **Item 24:** I ask myself if I could have used different SRL techniques after each teaching experience.
- **Item 25:** I ask myself questions about SRL teaching materials I am going to use.
- **Item 26:** I check regularly to what extent my students comprehend the topic of SRL while I am teaching.
- **Item 27:** After teaching a point about SRL. I ask myself if I'd teach it more effectively next time.
- **Item 28:** I organise my time to best accomplish my teaching goals about SRL.
- **Item 29:** I ask myself questions about how well I am doing while I am teaching about SRL.
- **Item 30:** I ask myself if I have considered all possible SRL techniques after teaching a point.

Means of middle-leaders' Likert-scale response scores to combined TEC-SRL items 19-30 are reported in Table 4.13. These response scores were taken at: pre-intervention, immediate

post-intervention and long-term post-intervention, difference between pre-intervention and immediate post-intervention and difference between pre-intervention and long-term post-intervention.

Table 4.13. Means for middle-leader Likert-scale responses for Items 19-30

Participant ID	Mean			Change score	
	Week 0 (n = 15)	Week 12 (n = 11)	Week 52 (n = 6)	Week 12 minus Week 0	Week 52 minus Week 0
ML1	3.58	5.83	4.75	2.25	1.17
ML2	3.17	5.92	6.08	2.75	2.91
ML3	2.08	6.00	-	3.92	-
ML4	4.00	6.25	NE	2.25	NE
ML5	2.67	5.42	3.58	2.75	0.91
ML6	4.33	4.25	A	-0.08	A
ML7	5.00	6.00	4.50	1.00	-0.50
ML8	5.33	6.00	5.50	0.67	0.17
ML9	-	5.75	5.50	-	-
ML10	3.42	-	-	-	-
ML11	3.42	4.33	A	0.91	A
ML12	2.00	3.58	-	1.58	-
ML13	5.25	-	-	-	-
ML14	5.33	W	W	W	W
ML15	2.25	-	-	-	-
ML16	5.50	-	NE	-	NE
Total change				20.33	10.16
Mean change				1.83	0.93

'-' = Not completed, NE = No longer employed on site, A = Absent – on leave, W = Withdrawn

Table 4.13 shows that prior to the PLC-ER about SRL at Week 0, five of the 15 middle-leaders who completed the pre-intervention TEC-SRL questionnaire (33%) scored 5 (including rounded to 5) or higher indicating engagement in metacognitive regulation of their epistemic cognition for teaching about SRL. Immediately after the PLC-ER about SRL at Week 12, eight of the 11 middle-leaders who completed the immediate post-intervention TEC-SRL questionnaire (73%) scored 5 (including rounded to 5) or higher indicating engagement in metacognitive regulation. Nine of the ten middle leaders who completed both pre- and immediate post-intervention questionnaires had increases between 0.67 and 3.92 points with the other middle leader recording a slight drop (-0.08). Overall there was a substantial *increase* in the metacognitive regulation for the ten middle leaders (mean change 1.83). The nine months after the PLC-ER about SRL at Week 52, three of the six middle-leaders who completed the long-term post-intervention TEC-SRL questionnaire (50%) scored 5 (including rounded to 5) or higher indicating engagement in metacognitive regulation. Three of the five who completed both pre-

intervention and long-term post-intervention questionnaires showed increases, while one showed decrease, with an overall *increase* in change (mean change 0.93).

A non-parametric Wilcoxon Signed-Ranks Tests was calculated on matched middle-leaders' (n=10) metacognitive regulation and indicated an *increase* from Week 0 (*Median* = 3.58) to Week 12 (*Median* = 5.83). This result was *statistically significant*, z = -2.705, p = 0.007 and it showed a large effect size of *r* = -0.53. Statistical measures were not conducted with Week 52 scores due to low sample sizes caused by participant attrition.

As stated at 2.4, metacognitive regulation plays a role in high-quality epistemic cognition (Barzilai & Chinn, 2018; Hofer, 2018; Lunn Brownlee et al., 2019). Therefore, noted improvements in school middle-leaders' metacognitive regulation of their epistemic cognition about SRL are positive outcomes.

4.6. Changes in Middle-Leader Self-Reported Teaching Practice About SRL

Changes in middle-leaders' self-reported teaching practice about SRL were measured using Likert scale (1-7, 1 = 0-15%; 2 = 16-30%; 3 = 31-45%; 4 = 46-60%; 5 = 61-75%; 6 = 76-90%; 7 = >90%) responses to TEC-SRL items:

- **Item 13:** In the past week, how many lessons have you explicitly set a teaching goal to develop students' knowledge about SRL?
- **Item 14:** In the past week, how many lessons have you explicitly set a teaching goal to assess students' knowledge about SRL
- **Item 32:** [Following item 31 'what is the best way to teach students SRL? Why?'] In the past week, how many lessons have you taught students' SRL in this way?
- **Item 33:** Explicitly teaching students about SRL strategies can improve student SRL knowledge. In the past week, how many lessons have you taught students' SRL in this way?
- **Item 35:** [Following item 34 'what is the best way to assess students' SRL? Why?'] In the past week, how many lessons have you assessed students' SRL in this way
- **Item 36:** Metacognitive prompts (e.g., what is your goal for this task?) can engage students in SRL and provide valuable feedback on how students are self-regulating their learning. In the past week, how many lessons have you incorporated metacognitive prompts in your teaching?

Means of middle-leaders' Likert-scale response scores to TEC-SRL items 13, 14, 32, 33, 35 and 36 are reported in Table 4.14. These response scores were taken at: pre-intervention, immediate post-intervention and long-term post-intervention, difference between

pre-intervention and immediate post-intervention and difference between pre-intervention and long-term post-intervention.

Table 4.14. Mean middle-leader Likert-scale response scores for Items 13-14, 32-33, 35-36

Participant ID	Mean			Change score	
	Week 0 (n = 15)	Week 12 (n = 11)	Week 52 (n = 6)	Week 12 minus Week 0	Week 52 minus Week 0
ML1	1.50	5.83	4.83	4.33	3.33
ML2	1.67	3.50	5.17	1.83	3.50
ML3	2.50	4.67	-	2.17	-
ML4	1.17	3.17	NE	2.00	NE
ML5	2.33	3.50	1.00	1.17	-1.33
ML6	2.50	5.00	A	2.50	A
ML7	3.33	3.17	2.00	-0.16	-1.33
ML8	3.00	3.17	3.67	0.17	0.67
ML9	-	5.50	4.83	-	-
ML10	2.17	-	-	-	-
ML11	1.17	2.17	A	1.00	A
ML12	1.00	2.17	-	1.17	-
ML13	4.83	-	-	-	-
ML14	2.83	W	W	W	W
ML15	2.50	-	-	-	-
ML16	2.50	-	NE	-	NE
Total change				16.18	4.84
Mean change				1.62	0.97

'-' = Not completed, NE = No longer employed on site, A = Absent – on leave, W = Withdrawn

Table 4.14 shows that prior to the PLC-ER about SRL at Week 0, one of the 15 middle-leaders who completed the pre-intervention TEC-SRL questionnaire (7%) scored 5 (rounded to 5) or higher indicating that they teach about SRL. Immediately following the PLC-ER about SRL at Week 12, four of the 11 middle-leaders who completed the immediate post-intervention TEC-SRL questionnaire (36%) scored 5 (rounded to 5) or higher indicating that they teach about SRL. However, drawing on change scores (refer Week 12 minus Week 0) apart for ML7 who reported a slight decline, all middle-leaders reported increases in their perception of their teaching practice about SRL. Eight of the ten who completed both pre-intervention and immediate post-intervention questionnaires showed increases (one substantial), while one showed decrease, with an overall *increase* of change (mean change +1.62). Nine months after the PLC-ER about SRL at Week 52, three of the six middle-leaders who completed long-term post-intervention TEC-SRL questionnaires (50%) scored 5 (rounded to 5) or higher indicating that they teach about SRL. Three of the five who completed both pre-intervention and

long-term post-intervention questionnaires showed increases, while two showed decreases, with an overall *increase* in change (mean change 0.97).

A non-parametric Wilcoxon Signed-Ranks Tests was calculated on matched middle-leaders' (n=10) self-reported teaching practice and indicated an *increase* in middle-leaders' self-reported teaching practice from Week 0 (*Median* = 2.50) to Week 12 (*Median* = 3.50). This result was *statistically significant*, z = -2.654, p = 0.008 and it showed a large effect size of *r* = -0.52. Statistical measures were not conducted with Week 52 scores due to low sample sizes caused by participant attrition.

Table 4.14 reported the middle-leaders' mean scores for self-reported teaching practice about SRL. To consider the more nuanced changes between items, Table 4.15 reports separately the items evaluating middle-leaders' self-reported teaching practice about SRL. These values are calculated at: pre-intervention and immediate post-intervention, plus the difference between these.

Table 4.15. Means for middle-leader Likert-scale responses for Items 13-14, 32-33, 35-36

	Mean (SD)		**Change score**
Item	**Week 0 (n = 15)**	**Week 12 (n = 11)**	**Week 12 minus Week 0**
For the following two items, please indicate percentage of total number of lessons taught **13:** In the past week, how many lessons have you explicitly set a teaching goal to develop students' knowledge about SRL?	2.07 (1.16)	4.18 (1.40)	2.11
14: In the past week, how many lessons have you explicitly set a teaching goal to assess students' knowledge about SRL	1.67 (0.90)	3.55 (1.92)	1.88
[Following item 31 "what is the best way to teach students SRL? Why?"] For the following two items, please indicate percentage of total number of lessons taught **32:** In the past week, how many lessons have you taught students' SRL in this way?	2.40 (1.30)	4.36 (1.29)	1.96
Explicitly teaching students about SRL strategies can improve student SRL knowledge **33:** In the past week, how many lessons have you taught students' SRL in this way?	2.00 (1.25)	4.09 (1.58)	2.09
[Following item 34 "what is the best way to assess students" SRL? Why?"] For the following two items, please indicate percentage of total number of lessons taught **35:** In the past week, how many lessons have you assessed students' SRL in this way	2.20 (1.66)	2.73 (1.19)	0.53

Metacognitive prompts (e.g., what is your goal for this task?) can engage students in SRL and provide valuable feedback on how students are self-regulating their learning. **36:** In the past week, how many lessons have you incorporated metacognitive prompts in your teaching?	3.67 (1.80)	3.91 (1.76)	0.24

In Table 4.15, values for Items 13 and 14 indicate that before the PLC-ER at Week 0, middle-leaders' didn't set a teaching goal (i.e., epistemic aim) for developing and/or assessing students' SRL. Immediately after participation in a PLC-ER about SRL at Week 12, middle-leaders' values indicate substantially higher levels of explicitly setting epistemic aims for students' SRL.

Similarly, in Table 4.15, values for Items 32 and 33 indicate that before the PLC-ER, school middle-leaders rarely explicitly taught students SRL strategies. Immediately after participation in a PLC-ER about SRL, middle-leaders' values indicate substantially higher levels of explicit teaching of students' SRL strategies.

In Table 4.15, values for Items 35 and 36 indicate that before the PLC-ER, school middle-leaders rarely incorporated teaching strategies that assessed students' SRL. Immediately after participation in a PLC-ER about SRL, middle-leaders' values indicate improvement in the assessment of students' SRL, although growth was minimal when compared to other practice related items reported in Table 4.15.

Overall, Table 4.15 illustrates that participation in a PLC-ER enhanced middle-leaders' practice for teaching about SRL. This finding was expected given the improvements in middle-leaders' beliefs reported thus far. Indeed, previous studies have indicated teachers' beliefs about SRL are positively associated with their teaching practice about SRL (Dignath-van Ewijk, 2016; Lombaerts, Backer, Engels, Braak, & Athanasou, 2009; Spruce & Bol, 2015). Furthermore, this finding is not surprising given the focus of the PLC-ER on teaching for SRL, but it demonstrates that this group of middle-leaders perceived their practice about SRL had improved with participation in the PLC-ER about SRL.

A positive perception about practice (i.e., success) may increase school middle-leaders' self-efficacy for teaching about SRL (Bandura, 1997, 2000). Researchers have reported positive associations between teachers' self-efficacy for teaching about SRL and their teaching practice (Karlen et al., 2020), thus suggesting that improvements in self-efficacy could lead to future incorporation of SRL teaching strategies in their classrooms. Alternatively, researchers have also argued that differences can exist between individuals self-reported practice (espoused theories) and their actual practice (theories in action) (Schön, 1987). This is further considered in Chapter 4, in comparison to observed teaching practice.

4.7. Changes in Middle-Leader Perceived Enablers and Barriers

Changes in middle-leaders' perceptions of enablers and barriers about SRL were measured using responses to nine TEC-SRL questionnaire closed-ended items and two TEC-SRL open-ended items, as detailed in the following sections.

4.7.1. Middle-leader perception of professional development about SRL

Middle-leaders' perceptions of professional development about SRL were measured using Likert scale (1-7, 1 = Very untrue; 7 = Very true) responses to two TEC-SRL items:

- **Item 38:** I have undertaken useful professional development about SRL
- **Item 39:** Many staff in my school have undertaken useful professional development about SRL

Middle-leaders' Likert-scale response scores to TEC-SRL Item 38 ("I have undertaken useful professional development about SRL") are reported in Table 4.16. These response scores were taken at: pre-intervention, immediate post-intervention and long-term post-intervention, difference between pre-intervention and immediate post-intervention and difference between pre-intervention and long-term post-intervention.

Table 4.16. Middle-leader Likert-scale responses for Item 38

Participant ID	Likert-scale response score (1 = Very untrue to 7 = Very true)			Change score	
	Week 0 (n = 15)	Week 12 (n = 11)	Week 52 (n = 6)	Week 12 minus Week 0	Week 52 minus Week 0
ML1	2.00	7.00	7.00	5.00	5.00
ML2	2.00	7.00	7.00	5.00	5.00
ML3	2.00	7.00	-	5.00	-
ML4	5.00	6.00	NE	1.00	NE
ML5	1.00	6.00	6.00	5.00	5.00
ML6	4.00	5.00	A	1.00	A
ML7	5.00	6.00	5.00	1.00	0.00
ML8	5.00	7.00	7.00	2.00	2.00
ML9	-	7.00	7.00	-	-
ML10	2.00	-	-	-	-
ML11	1.00	5.00	A	4.00	A
ML12	2.00	6.00	-	4.00	-
ML13	3.00	-	-	-	-
ML14	2.00	W	W	W	W
ML15	1.00	-	-	-	-
ML16	4.00	-	NE	-	NE

Total change	33.00	17.00
Mean change	3.30	3.40

'-' = Not completed, NE = No longer employed on site, A = Absent – on leave, W = Withdrawn

Table 4.16 shows that prior to the PLC-ER about SRL at Week 0, three of 15 middle-leaders who completed the pre-intervention TEC-SRL questionnaire (20%) scored 5 or higher indicating a belief that they had undertaken useful professional education about SRL. This is concerning given researchers have reported that lack of training is a barrier to sustainability of school improvement initiatives (Turri et al., 2016). Immediately after the PLC-ER about SRL at Week 12, all 11 middle-leaders who completed the immediate post-intervention TEC-SRL questionnaire (100%) scored 5 or higher indicating a belief that that they had undertaken useful professional development about SRL. Of the ten middle-leaders who completed both pre- and immediate post-intervention questionnaires there was an overall *increase* in the strength of the belief about the usefulness of professional education (mean change 3.30). Nine months after the PLC-ER about SRL at Week 52, all six middle-leaders who completed the long-term post-intervention TEC-SRL questionnaire (100%) scored 5 or higher indicating a belief that they had undertaken useful professional development about SRL, the five who had completed pre-internention and long-term post-intervention surveys having an overall *increase* in change (mean change 3.40).

A non-parametric Wilcoxon Signed-Ranks Tests was calculated on matched middle-leaders' (n=10) Likert-scale responses to TEC-SRL item 38 and indicated an *increase* from Week 0 (*Median* = 2.00) to Week 12 (*Median* = 6.00). This result was *statistically significant*, z = -2.831, p = 0.005 and it showed a large effect size of *r* = -0.56. Statistical measures were not conducted with Week 52 scores due to low sample sizes caused by participant attrition. This is a welcome positive finding and implies that middle-leaders found the PLC-ER a useful professional education program.

Middle-leaders' Likert-scale response scores to TEC-SRL Item 39 (Many staff in my school have undertaken useful professional development about SRL) are reported in Table 4.17. These response scores were taken at: pre-intervention, immediate post-intervention and long-term post-intervention, difference between pre-intervention and immediate post-intervention and difference between pre-intervention and long-term post-intervention.

Table 4.17. Middle-leader Likert-scale responses for Item 39

Participant ID	Likert-scale response score (1 = Very untrue to 7 = Very true)			Change score	
	Week 0 (n = 15)	Week 12 (n = 11)	Week 52 (n = 6)	Week 12 minus Week 0	Week 52 minus Week 0
ML1	2.00	6.00	5.00	4.00	3.00
ML2	4.00	3.00	2.00	-1.00	-2.00

ML3	2.00	7.00	-	5.00	-
ML4	3.00	3.00	NE	0.00	NE
ML5	3.00	5.00	6.00	2.00	3.00
ML6	4.00	5.00	A	1.00	A
ML7	5.00	5.00	3.00	0.00	-2.00
ML8	4.00	6.00	7.00	2.00	3.00
ML9	-	6.00	6.00	-	-
ML10	4.00	-	-	-	-
ML11	4.00	5.00	A	1.00	A
ML12	4.00	4.00	-	0.00	-
ML13	3.00	-	-	-	-
ML14	2.00	W	W	W	W
ML15	4.00	-	-	-	-
ML16	5.00	-	NE	-	NE
Total change				14.00	5.00
Mean change				1.40	1.00

'-' = Not completed, NE = No longer employed on site, A = Absent – on leave, W = Withdrawn

Table 4.17 shows that prior to the PLC-ER about SRL at Week 0, two of the 15 middle-leaders who completed the pre-intervention TEC-SRL questionnaire (13%) scored 5 or higher indicating a belief that many staff had undertaken useful professional education about SRL. Immediately after the PLC-ER about SRL at Week 12, eight of the 11 middle-leaders who completed the immediate post-intervention TEC-SRL questionnaire (73%) scored 5 or higher indicating a belief that many staff in their school had undertaken useful professional development about SRL. Six of the ten who completed both pre- and immediate post-intervention questionnaires showed increases, with an overall *increase* in the strength of this belief (mean change 1.40). Nine months after the PLC-ER about SRL at Week 52, four of the six middle-leaders who completed the long-term post-intervention TEC-SRL questionnaire (67%) scored 5 or higher indicating a belief that many staff had undertaken useful professional development about SRL. However, of the five who completed both pre-intervention and long-term post-intervention questionnaires, three showed increases while two showed decreases, with an overall *increase* in change (mean change 1.00).

A non-parametric Wilcoxon Signed-Ranks Tests was calculated on matched middle-leaders' (n=10) Likert-scale responses to TEC-SRL Item 39 and indicated an *increase* from Week 0 (*Median* = 4.00) to Week 12 (*Median* = 5.00). This result was *statistically significant*, z = -2.047, p = 0.041 and it showed a medium effect size of *r* = -0.40. Statistical measures were not conducted with Week 52 scores due to low sample sizes caused by participant attrition.

The increase in perception that many staff had undertaken useful professional development about SRL was interesting as only middle-leaders had been involved in the PLC-ER about SRL. Hence, it was unclear what professional development middle-leaders were referring to in this instance.

4.7.2. Middle-leader perception of school environment

Middle-leaders' perceptions of the school environment about SRL were measured using Likert scale (1-7, 1 = Very untrue; 7 = Very true) responses to five TEC-SRL items:

- **Item 37:** Leadership staff in my school support explicit teaching of SRL
- **Item 40:** My school regularly reports to staff our progress with developing students' SRL
- **Item 41:** Promoting students' SRL is included in our school mission statements
- **Item 42:** Our parent community supports us teaching about SRL
- **Item 43:** In my school, developing students' knowledge about SRL forms part of the curriculum

Middle-leaders' Likert-scale response scores to TEC-SRL Item 37 are reported in Table 4.18. These response scores were taken at: pre-intervention, immediate post-intervention and long-term post-intervention, difference between pre-intervention and immediate post-intervention and difference between pre-intervention and long-term post-intervention.

Table 4.18. Middle-leader Likert-scale responses for Item 37

Participant ID	Likert-scale response score (1 = Very untrue to 7 = Very true)			Change score	
	Week 0 (n = 15)	Week 12 (n = 11)	Week 52 (n = 6)	Week 12 minus Week 0	Week 52 minus Week 0
ML1	4.00	5.00	6.00	1.00	2.00
ML2	6.00	7.00	5.00	1.00	-1.00
ML3	2.00	7.00	-	5.00	-
ML4	5.00	5.00	NE	0.00	NE
ML5	5.00	6.00	2.00	1.00	-3.00
ML6	4.00	4.00	A	0.00	A
ML7	5.00	6.00	4.00	1.00	-1.00
ML8	7.00	7.00	7.00	0.00	0.00
ML9	-	6.00	7.00	-	-
ML10	5.00	-	-	-	-
ML11	5.00	4.00	A	-1.00	A
ML12	4.00	4.00	-	0.00	-
ML13	6.00	-	-	-	-
ML14	7.00	W	W	W	W

ML15	7.00	-	-	-	-
ML16	5.00	-	NE	-	NE
Total change				8.00	-3.00
Mean change				0.80	-0.60

'-' = Not completed, NE = No longer employed on site, A = Absent – on leave, W = Withdrawn

Table 4.18 shows that prior to the PLC-ER about SRL at Week 0, 11 of 15 middle-leaders who completed the pre-intervention TEC-SRL questionnaire (73%) scored 5 or higher indicating a belief that leadership staff support the teaching of SRL.

The perception of leadership staff supporting the SRL teaching initiative is consistent with De Smul et al's (2018) survey study that found that school leaders influenced the explicit teaching of SRL strategies. The importance of leadership support is not surprising, as the implementation of professional education about SRL at the school prior to this study required the approval of the school administrators, logistical implementation and a direct school investment. Given the role of leadership documented in previous studies (refer section 1.3), this is a particularly positive finding.

Immediately after the PLC-ER about SRL at Week 12, five of the 10 middle-leaders who also completed the immediate post-intervention TEC-SRL questionnaire (50%) scored 5 or higher indicating a belief that leadership staff support the teaching of SRL, with an overall group *increase* in the strength of this belief (mean change 0.80). Nine months after the PLC-ER about SRL at Week 52, four of the six middle-leaders who completed the long-term post-intervention TEC-SRL questionnaire (67%) scored 5 or higher indicating a belief that leadership staff support the teaching of SRL. There was an overall *decrease* in change (mean change -0.60) for middle-leaders who completed both a pre-intervention and long-term post-intervention questionnaire, with three of the five indicating a *decrease*.

A non-parametric Wilcoxon Signed-Ranks Tests was calculated on matched middle-leaders' (n=10) Likert-scale responses to TEC-SRL Item 37 and indicated an *increase* from Week 0 (*Median* = 5.00) to Week 12 (*Median* = 6.00). This result was *not statistically significant*, z = -1.667, p = 0.096. Statistical measures were not conducted with Week 52 scores due to low sample sizes caused by participant attrition.

Acknowledging the increase between Week 0 to Week 12 was not significant, and Week 0 to Week 52 was slightly negative, many participating middle-leaders' responses indicated a perception that leadership staff in the school supported explicit teaching of SRL strategies. This perception was even present with a change of principal that occurred at the beginning of 2020.

Middle-leaders' Likert-scale response scores to TEC-SRL Item 40 (My school regularly reports to staff our progress with developing students' SRL) are reported in Table 4.19. These response scores were taken at: pre-intervention, immediate post-intervention and long-term

post-intervention, difference between pre-intervention and immediate post-intervention and difference between pre-intervention and long-term post-intervention.

Table 4.19. Middle-leader Likert-scale responses for Item 40

Participant ID	Likert-scale response score (1 = Very untrue to 7 = Very true)			Change score	
	Week 0 (n = 15)	Week 12 (n = 11)	Week 52 (n = 6)	Week 12 minus Week 0	Week 52 minus Week 0
ML1	5.00	6.00	5.00	1.00	0.00
ML2	2.00	2.00	1.00	0.00	-1.00
ML3	5.00	6.00	-	1.00	-
ML4	2.00	3.00	NE	1.00	NE
ML5	4.00	6.00	2.00	2.00	-2.00
ML6	5.00	4.00	A	-1.00	A
ML7	5.00	5.00	3.00	0.00	-2.00
ML8	6.00	6.00	5.00	0.00	-1.00
ML9	-	3.00	3.00	-	-
ML10	2.00	-	-	-	-
ML11	5.00	4.00	A	-1.00	A
ML12	4.00	3.00	-	-1.00	-
ML13	6.00	-	-	-	-
ML14	2.00	W	W	W	W
ML15	4.00	-	-	-	-
ML16	5.00	-	NE	-	NE
Total change				2.00	-6.00
Mean change				0.20	-1.20

'-' = Not completed, NE = No longer employed on site, A = Absent – on leave, W = Withdrawn

Table 4.19 shows that prior to the PLC-ER about SRL at Week 0, eight of 15 middle-leaders who completed the pre-intervention TEC-SRL questionnaire (53%) scored 5 or higher indicating a belief that the school regularly reported to staff progress about SRL. Immediately after the PLC-ER about SRL at Week 12, five of the 11 middle-leaders who completed the immediate post-intervention TEC-SRL questionnaire (45%) scored 5 or higher indicating a belief that the school regularly reported to staff progress about SRL. While this result indicates a lower percentage of middle-leaders who agreed, Of the ten who completed both pre- and immediate post-intervention, four showed increases and three decreases in agreement, resulting in an overall *increase* in the strength of this belief (mean change 0.20). Nine months after the PLC-ER about SRL at Week 52, two of the six middle-leaders who completed the long-term post-intervention TEC-SRL questionnaire (33%) scored 5 or higher indicating a belief that the school regularly reported to staff progress about SRL. Four of the five who completed

both pre-intervention and long-term post-intervention questionnaires showed decrease, with an overall *decrease* in change (mean change -1.20).

A non-parametric Wilcoxon Signed-Ranks Tests was calculated on matched middle-leaders' (n=10) Likert-scale responses to TEC-SRL item 40 and indicated a *decrease* from Week 0 (*Median* = 5.00) to Week 12 (*Median* = 4.00). This result was *not statistically significant*, z = -0.632, p = 0.527. Statistical measures were not conducted with Week 52 scores due to low sample sizes caused by participant attrition.

TEC-SRL item 40 (My school regularly reports to staff our progress with developing students' SRL) required middle-leaders to indicate their perception of how well this progress was being reported. I had not defined from which direction this "progress" was being reported, nor is it clear how middle-leaders interpreted this item. Reporting short-term progress/results has been argued as "necessary to build trust with the public or shareholders for longer-term investments" (Fullan, 2006, p. 120). Making progress visible increases teachers' motivation for implementing the practice (Han & Weiss, 2005), so middle-leaders' perceptions that the school was not reporting progress may have influenced the quality of their implementation.

Middle-leaders' Likert-scale response scores to TEC-SRL item 41 (Promoting students' SRL is included in our school mission statements) are reported in Table 4.20. These response scores were taken at: pre-intervention, immediate post-intervention and long-term post-intervention, difference between pre-intervention and immediate post-intervention and difference between pre-intervention and long-term post-intervention.

Table 4.20. Middle-leader Likert-scale responses for Item 41

Participant ID	Likert-scale response score (1 = Very untrue to 7 = Very true)			Change score	
	Week 0 (n = 15)	Week 12 (n = 11)	Week 52 (n = 6)	Week 12 minus Week 0	Week 52 minus Week 0
ML1	4.00	6.00	5.00	2.00	1.00
ML2	6.00	2.00	4.00	-4.00	-2.00
ML3	2.00	4.00	-	2.00	-
ML4	2.00	3.00	NE	1.00	NE
ML5	5.00	6.00	4.00	1.00	-1.00
ML6	5.00	5.00	A	0.00	A
ML7	5.00	6.00	7.00	1.00	2.00
ML8	6.00	6.00	6.00	0.00	0.00
ML9	-	7.00	7.00	-	-
ML10	7.00	-	-	-	-
ML11	5.00	4.00	A	-1.00	A
ML12	4.00	4.00	-	0.00	-
ML13	6.00	-	-	-	-

ML14	4.00	W	W	W	W
ML15	4.00	-	-	-	-
ML16	6.00	-	NE	-	NE
Total change				2.00	0.00
Mean change				0.20	0.00

'-' = Not completed, NE = No longer employed on site, A = Absent – on leave, W = Withdrawn

Table 4.20 shows that prior to the PLC-ER about SRL at Week 0, nine of 15 middle-leaders who completed the pre-intervention TEC-SRL questionnaire (60%) scored 5 or higher indicating a belief that promoting students' SRL was included in the school's mission. Immediately after the PLC-ER about SRL at Week 12, six of the 11 middle-leaders who completed the immediate post-intervention TEC-SRL questionnaire (55%) scored 5 or higher indicating a belief that promoting students' SRL was included in the school's mission. Five of the ten who completed both pre- and immediate post-intervention questionnaires showed increases in the strength of this belief, with two decreases (one substantial) and an overall *increase* (mean change 0.20). Nine months after the PLC-ER about SRL at Week 52, four of the six middle-leaders who completed the long-term post-intervention TEC-SRL questionnaire (67%) scored 5 or higher indicating a belief that promoting students' SRL was included in the school's mission. Of the five who completed both pre-intervention and long-term post-intervention questionnaires, two showed increases, two decreases and overall *no change* (mean change 0.00).

A non-parametric Wilcoxon Signed-Ranks Tests was calculated on middle-leaders' Likert-scale responses to TEC-SRL item 41 and indicated *no change* from Week 0 to Week 12.

Researchers have suggested that a school's vision and mission provide direction to school personnel (De Smul et al., 2018; Heirweg et al., 2020; M. James & McCormick, 2009). Furthermore, Thomas et al. (2020), in their survey study of 591 teachers about their practice, beliefs and perceptions of school mechanisms that determined SRL teaching practice, reported that school policy was the only school mechanism that also correlated with the teaching of SRL in elementary education. Low perceptions of a school mission toward students' SRL may explain the lack of SRL teaching initiatives in the school (Dignath & Büttner, 2018) and teaching behaviours observed (lesson observation data is discussed in detail in Chapter 3.9).

Middle-leaders' Likert-scale response scores to TEC-SRL Item 42 (Our parent community supports us teaching about SRL) are reported in Table 4.21. These response scores were taken at: pre-intervention, immediate post-intervention and long-term post-intervention, difference between pre-intervention and immediate post-intervention and difference between pre-intervention and long-term post-intervention.

Table 4.21. Middle-leader Likert-scale responses for Item 42

Participant ID	Likert-scale response score (1 = Very untrue to 7 = Very true)			Change score	
	Week 0 (n = 15)	Week 12 (n = 11)	Week 52 (n = 6)	Week 12 minus Week 0	Week 52 minus Week 0
ML1	5.00	4.00	5.00	-1.00	0.00
ML2	4.00	4.00	4.00	0.00	0.00
ML3	2.00	6.00	-	4.00	-
ML4	2.00	3.00	NE	1.00	NE
ML5	4.00	4.00	4.00	0.00	0.00
ML6	5.00	4.00	A	-1.00	A
ML7	5.00	5.00	4.00	0.00	-1.00
ML8	4.00	4.00	5.00	0.00	1.00
ML9	-	5.00	7.00	-	-
ML10	6.00	-	-	-	-
ML11	4.00	4.00	A	0.00	A
ML12	4.00	4.00	-	0.00	-
ML13	5.00	-	-	-	-
ML14	4.00	W	W	W	W
ML15	7.00	-	-	-	-
ML16	5.00	-	NE	-	NE
Total change				3.00	0.00
Mean change				0.30	0.00

'-' = Not completed, NE = No longer employed on site, A = Absent – on leave, W = Withdrawn

Table 4.21 shows that prior to the PLC-ER about SRL at Week 0, seven of the 15 middle-leaders who completed the pre-intervention TEC-SRL questionnaire (47%) scored 5 or higher indicating a belief that the parent community supported them teaching about SRL. A large proportion of middle-leaders (40%) neither agreed or disagreed that their parent community was supportive of the teaching of SRL strategies. Immediately after the PLC-ER about SRL at Week 12, three of the 11 middle-leaders who completed the immediate post-intervention TEC-SRL questionnaire (27%) scored 5 or higher indicating a belief that the parent community supported them teaching about SRL, a reduction in agreement from Week 0. Two of the ten who completed both pre- and immediate post-intervention questionnaires showed increases (one very substantial) in the strength of this belief (20%), with two decreases and an overall *increase* (mean change 0.30), largely due to the change in ML3. Nine months after the PLC-ER about SRL at Week 52, three of the six middle-leaders who completed the long-term post-intervention TEC-SRL questionnaire (50%) scored 5 or higher indicating a belief that the parent community supported their teaching about SRL, indicating *no change* overall (mean change 0.00).

A non-parametric Wilcoxon Signed-Ranks Tests was calculated on matched middle-leaders' Likert-scale responses to TEC-SRL item 42 and indicated *no change* from Week 0 to Week 12.

Support from the parent community has been documented as a condition for sustainability (Pinkelman et al., 2015), so a neutral sense of the parents' engagement and support for students' SRL may negatively influence the integration of SRL teaching initiatives into the school.

Middle-leaders' Likert-scale response scores to TEC-SRL item 43 (In my school, developing students' knowledge about SRL forms part of the curriculum) are reported in Table 4.22. These response scores were taken at: pre-intervention, immediate post-intervention and long-term post-intervention, difference between pre-intervention and immediate post-intervention and difference between pre-intervention and long-term post-intervention.

Table 4.22. Middle-leader Likert-scale responses for Item 43

Participant ID	Likert-scale response score (1 = Very untrue to 7 = Very true)			Change score	
	Week 0 (n = 15)	Week 12 (n = 11)	Week 52 (n = 6)	Week 12 minus Week 0	Week 52 minus Week 0
ML1	5.00	5.00	4.00	0.00	-1.00
ML2	6.00	5.00	5.00	-1.00	-1.00
ML3	2.00	7.00	-	5.00	-
ML4	2.00	3.00	NE	1.00	NE
ML5	5.00	5.00	3.00	0.00	-2.00
ML6	5.00	4.00	A	-1.00	A
ML7	5.00	5.00	3.00	0.00	-2.00
ML8	6.00	6.00	5.00	0.00	-1.00
ML9	-	6.00	2.00	-	-
ML10	6.00	-	-	-	-
ML11	4.00	3.00	A	-1.00	A
ML12	4.00	4.00	-	0.00	-
ML13	3.00	-	-	-	-
ML14	5.00	W	W	W	W
ML15	4.00	-	-	-	-
ML16	5.00	-	NE	-	NE
Total change				3.00	-7.00
Mean change				0.30	-1.40

'-' = Not completed, NE = No longer employed on site, A = Absent – on leave, W = Withdrawn

Table 4.22 shows that prior to the PLC-ER about SRL at Week 0, nine of the 15 middle-leaders who completed the pre-intervention TEC-SRL questionnaire (60%) scored 5 or higher, which indicates belief that SRL formed part of the curriculum. Immediately following the PLC-ER

about SRL at Week 12, seven of the 11 middle-leaders who completed the immediate post-intervention TEC-SRL questionnaire (64%) scored 5 or higher, which indicates belief that SRL formed part of the curriculum. Two of the ten who completed both pre- and immediate post-intervention questionnaires showed increases (one very substantial) in the strength of this belief (20%), with three decreases and an overall *increase* (mean change 0.30), largely due to the change in ML3. Nine months after the PLC-ER about SRL at Week 52, two of the six middle-leaders who completed the long-term post-intervention TEC-SRL questionnaire (50%) scored 5 or higher indicating a belief that SRL formed part of the curriculum. However, of the five who completed both pre-intervention and long-term post-intervention questionnaires, all showed decreases, with an overall *decrease* in change (mean change -1.40).

A non-parametric Wilcoxon Signed-Ranks Tests was calculated on matched middle-leaders' (n=10) Likert-scale responses to TEC-SRL item 43 and indicated *no change* from Week 0 to Week 12.

Competing priorities (Turri et al., 2016) and a perception that SRL is not part of the curriculum, are barriers to sustainability of school improvement initiatives about SRL. Findings indicate many middle-leaders reported SRL was not part of the curriculum, suggesting it may have been a competing priority to their work associated with the regular curriculum and therefore, a barrier to their implementation (Turri et al., 2016) of explicit teaching of SRL strategies in the classroom.

4.7.3. Middle-leader perception of longevity of SRL

Middle-leaders' perceptions of the longevity of SRL were measured using Likert scale (1-7, 1 = Very untrue; 7 = Very true) responses to two TEC-SRL items:

- **Item 44:** If the key staff who promote SRL were to leave our school the emphasis on it would probably die out
- **Item 45:** In truth, SRL is a current fad, that will eventually be replaced by the next 'big thing'

Middle-leaders' Likert-scale response scores to TEC-SRL Item 44 are reported in Table 4.23. These response scores were taken at: pre-intervention, immediate post-intervention and long-term post-intervention, difference between pre-intervention and immediate post-intervention and difference between pre-intervention and long-term post-intervention.

Table 4.23. Middle-leader Likert-scale responses for Item 44

Participant ID	Likert-scale response score (1 = Very untrue to 7 = Very true)			Change score	
	Week 0 (n = 15)	Week 12 (n = 11)	Week 52 (n = 6)	Week 12 minus Week 0	Week 52 minus Week 0
ML1	3.00	5.00	5.00	2.00	2.00
ML2	4.00	5.00	5.00	1.00	1.00

ML3	4.00	5.00	-	1.00	-
ML4	6.00	6.00	NE	0.00	NE
ML5	4.00	5.00	6.00	1.00	2.00
ML6	4.00	4.00	A	0.00	A
ML7	5.00	5.00	7.00	0.00	2.00
ML8	2.00	4.00	2.00	2.00	0.00
ML9	-	5.00	6.00	-	-
ML10	2.00	-	-	-	-
ML11	3.00	6.00	A	3.00	A
ML12	4.00	4.00	-	0.00	-
ML13	6.00	-	-	-	-
ML14	6.00	W	W	W	W
ML15	2.00	-	-	-	-
ML16	2.00	-	NE	-	NE
Total change				10.00	7.00
Mean change				1.00	1.40

'-' = Not completed, NE = No longer employed on site, A = Absent – on leave, W = Withdrawn

Table 4.23 shows that prior to the PLC-ER about SRL at Week 0, four of the 15 middle-leaders who completed the pre-intervention TEC-SRL questionnaire (27%) scored 5 or higher, which indicates belief that if key staff who promote SRL were to leave the school, emphasis on SRL teaching would decline. Immediately following the PLC-ER about SRL at Week 12, eight of the 11 middle-leaders who completed the immediate post-intervention TEC-SRL questionnaire (73%) scored 5 or higher, which indicates belief that if key staff who promote SRL were to leave the school, emphasis would decline. Seven of the ten who completed both pre- and immediate post-intervention questionnaires showed increases (one substantial) in the strength of this belief (70%) and an overall *increase* in change (mean change 1.00). Nine months after the PLC-ER about SRL at Week 52, five of the six middle-leaders who completed the long-term post-intervention TEC-SRL questionnaire (83%) scored 5 or higher indicating a belief that key staff who promote SRL were to leave the school, emphasis would decline. Of the five who completed both pre-intervention and long-term post-intervention questionnaires, four showed increases, with an overall *increase* in change (mean change 1.40).

A non-parametric Wilcoxon Signed-Ranks Tests was calculated on matched middle-leaders' (n=10) Likert-scale responses to TEC-SRL item 44 and indicated an *increase* in middle-leaders' Likert-scale responses to TEC-SRL item 44 from Week 0 (*Median* = 4.00) to Week 12 (*Median* = 5.00). This result was *statistically significant*, z = -2.232, p = 0.026 and it showed a medium effect size of *r* = -0.44. Statistical measures were not conducted with Week 52 scores due to low sample sizes caused by participant attrition.

In the same way that lesson planning protocols or educative tools for epistemic reflexivity have be advocated to encourage engagement in reflecting about SRL (Barr & Askell-Williams, 2020b; Giovannelli, 2003), key staff who promote SRL act as further prompt and reminders of SRL. Implications of this finding are further discussed in the Conclusions, Recommendations and Implications chapter at Section 9.1.4.

Middle-leaders' Likert-scale response scores to TEC-SRL Item 45 are reported in Table 4.24. These response scores were taken at: pre-intervention, immediate post-intervention and long-term post-intervention, difference between pre-intervention and immediate post-intervention and difference between pre-intervention and long-term post-intervention.

Table 4.24. Middle-leader Likert-scale responses for Item 45

Participant ID	Likert-scale response score (1 = Very untrue to 7 = Very true)			Change score	
	Week 0 (n = 15)	Week 12 (n = 11)	Week 52 (n = 6)	Week 12 minus Week 0	Week 52 minus Week 0
ML1	2.00	2.00	2.00	0.00	0.00
ML2	2.00	1.00	1.00	-1.00	-1.00
ML3	1.00	4.00	-	3.00	-
ML4	5.00	3.00	NE	-2.00	NE
ML5	4.00	3.00	6.00	-1.00	2.00
ML6	2.00	4.00	A	2.00	A
ML7	5.00	4.00	3.00	-1.00	-2.00
ML8	1.00	3.00	1.00	2.00	0.00
ML9	-	2.00	2.00	-	-
ML10	1.00	-	-	-	-
ML11	7.00	5.00	A	-2.00	A
ML12	4.00	5.00	-	1.00	-
ML13	4.00	-	-	-	-
ML14	6.00	W	W	W	W
ML15	1.00	-	-	-	-
ML16	2.00	-	NE	-	NE
Total change				1.00	-1.00
Mean change				0.10	-0.20

'-' = Not completed, NE = No longer employed on site, A = Absent – on leave, W = Withdrawn

Table 4.24 shows that prior to the PLC-ER about SRL at Week 0, four of the 15 middle-leaders who completed the pre-intervention TEC-SRL questionnaire (27%) scored 5 or higher, which indicates belief that SRL is a fad that would eventually die out. Immediately following the PLC-ER about SRL at Week 12, two of the 11 middle-leaders who completed the immediate post-intervention TEC-SRL questionnaire (18%) scored 5 or higher, which indicates belief that SRL is a fad that would eventually die out. Four of the ten who completed both pre-intervention

and immediate post-intervention questionnaires showed increases (one substantial), while five showed decreases, with an overall *increase* of change (mean change 0.10). Nine months after the PLC-ER about SRL at Week 52, one of the six middle-leaders who completed the long-term post-intervention TEC-SRL questionnaire (17%) scored 5 or higher indicating a belief that SRL was a fad that would eventually die out. Of the five who completed both pre-intervention and long-term post-intervention questionnaires, one showed an increase and two decreases, with an overall *decrease* in change (mean change -0.20).

A non-parametric Wilcoxon Signed-Ranks Tests was calculated on matched middle-leaders' (n=10) Likert-scale responses to TEC-SRL item 45 and indicated an *increase* from Week 0 (*Median* = 2.00) to Week 12 (*Median* = 3.00). This result was *not statistically significant*, z = -0.241, p = 0.809. Statistical measures were not conducted with Week 52 scores due to low sample sizes caused by participant attrition.

The common stance of middle-leaders' beliefs that SRL was *not* a fad was relatively consistent across all three time-points, which is a positive finding in relation to the literature reviewed in this thesis. A view of SRL as a temporary innovation may lead to reduced staff motivation for implementing SRL teaching initiatives. Researchers have reported that *staff buy in* is a key condition for the sustainability of school improvement initiatives (Pinkelman et al., 2015; Turri et al., 2016).

4.7.4. Perceived enablers and barriers

Changes in middle-leaders' perceptions of enablers and barriers to explicit teaching of SRL strategies were also measured using responses to two TEC-SRL open-ended items:

- **Item 46:** What is the most important factor for sustained implementation of explicit teaching of SRL? Please explain.
- **Item 47:** What is the most significant barrier to sustaining explicit teaching of SRL? Please explain.

These statements were coded to thematic categories. Figure 4.4 documents the frequency of six enabling factors that emerged from the participants' responses.

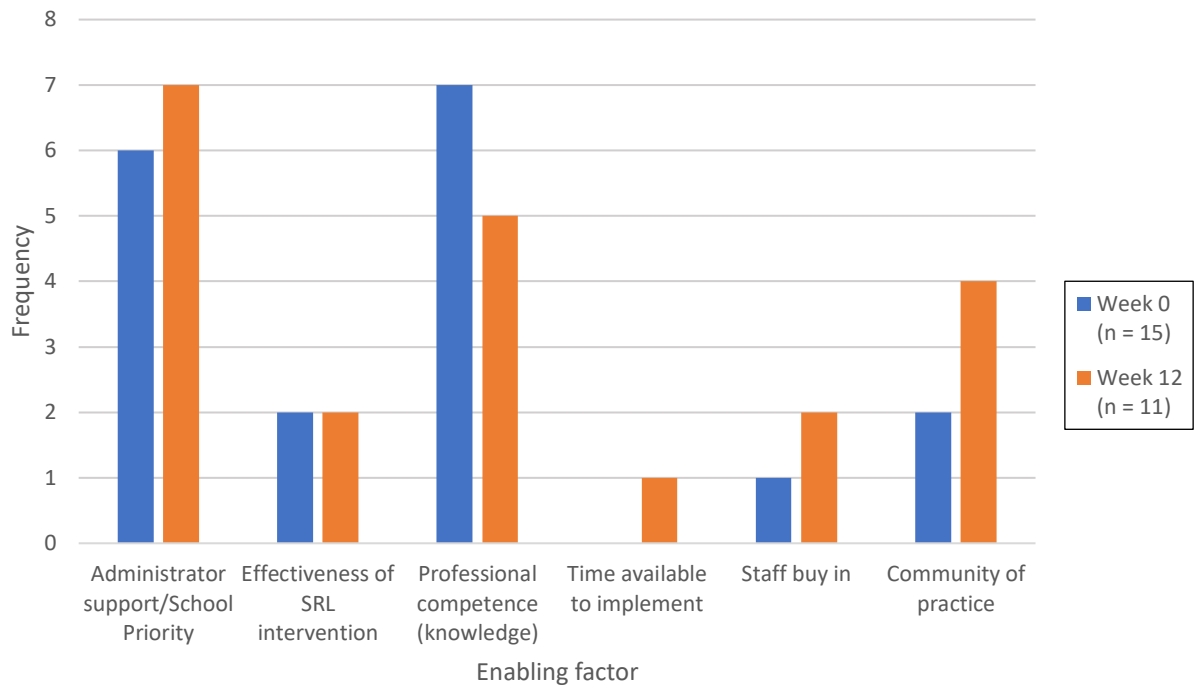

Figure 4.4. Frequency of enabling factors for explicit teaching of SRL strategies

Figure 4.4 illustrates that prior to the PLC-ER about SRL at Week 0, middle-leaders reported several enablers to implementation of SRL teaching initiatives. *Professional competence (knowledge)* was the most prominent, closely followed by *administrator support*.

The prominence of *professional competence* indicates that that possessing high quality knowledge, beliefs and skills for school improvement initiatives about SRL, is required for implementation. This is further evidence for the importance of designing and implementing professional education programs about SRL with educational leaders and teachers.

Middle-leaders' statements suggested that to embed the explicit teaching of SRL strategies in schools, key administrators must ensure that it is a school priority and that staff are supported throughout implementation. It is possible that the shift in school leadership/Principal caused middle-leaders to critically think about the role of the principal in supporting the promotion of SRL. This is consistent with other studies that have reported school administrator support as a key enabler of sustainability of school improvement initiatives (Pinkelman et al., 2015).

Figure 4.5 reports the frequency of hindering factors (barriers) for the sustainability of explicit teaching of SRL strategies.

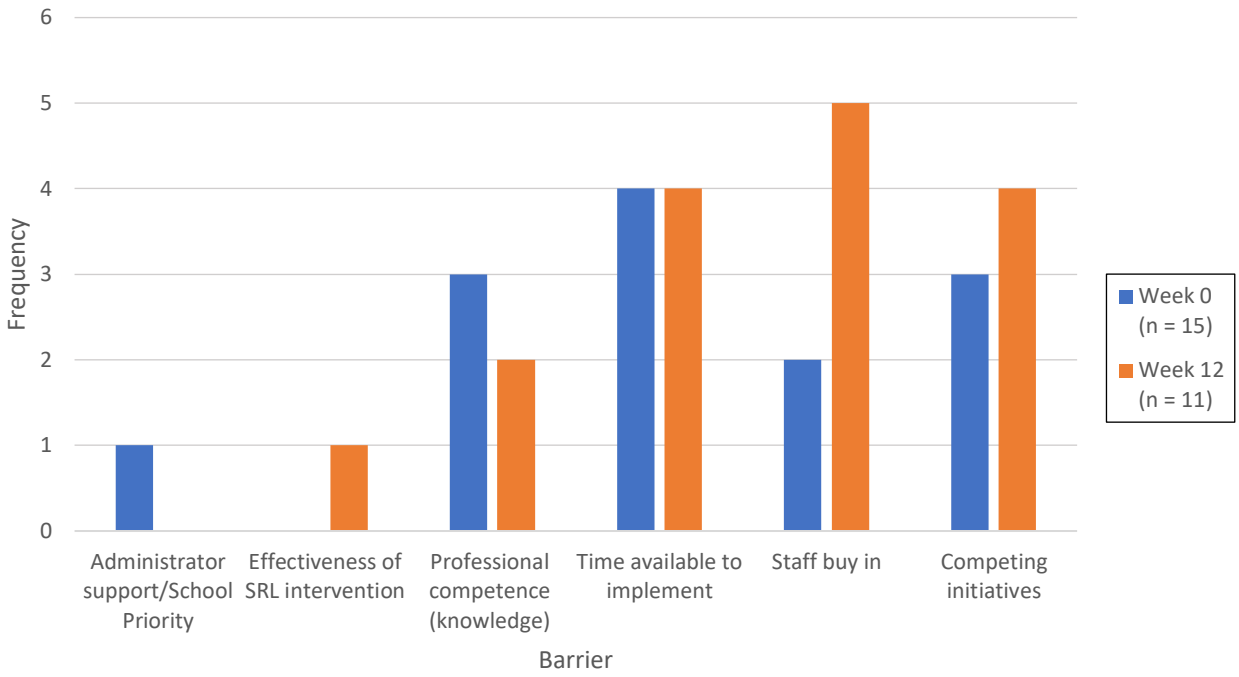

Figure 4.5. Frequency of barriers to explicit teaching of SRL strategies

Figure 4.5 illustrates that prior to the PLC-ER about SRL at Week 0, middle-leaders reported several barriers to implementation of SRL teaching initiatives. *Time* was the most prominent, closely followed by *professional competence (knowledge)* and *competing initiatives* (other initiatives that demand attention).

Bambara, Goh, Kern, and Caskie (2012), in their survey study of 293 school staff's perceptions of enablers and barriers to a school improvement initiative, reported that "the most problematic barriers… consisted of factors largely related to beliefs, *time*, and *training*" (p. 228, *emphasis added*). Alternatively, *time* and *competing initiatives* relate to Eccles and Wigfield's (2002) value dimension *cost:* "the negative aspects of engaging in the task, such as performance anxiety…, the amount of effort needed to succeed and the lost opportunities that result from making one choice rather than another" (p. 120). Teachers who value knowledge about SRL will endeavour to develop their knowledge about their students SRL abilities, and subsequently seek to promote SRL knowledge construction in their students, but as Chinn et al. (2011) suggested this adoption and development will occur: "only if they judge that the value of the knowledge exceeds the costs of acquisition (e.g., the time and effort required)" (p. 149). This points to a potential incongruence between middle-leaders' self-reported epistemic value (as per their responses to the two TEC-SRL items, refer section 4.3) and inferred epistemic value from other items.

Immediately after engagement in the PLC-ER about SRL at Week 12, middle-leaders' continued to report *time to implement* and *competing initiatives* as two barriers to the implementation of SRL teaching initiatives. However, *staff buy in* (interest and motivation of

teaching staff) was reported as the greatest barrier. Of perhaps greater interest is that *staff buy in* showed the biggest change over the course of the PLC-ER about SRL and highlights that for some staff support/interest may have been lacking.

Pinkelman et al. (2015), in their open-ended survey study with school staff from 860 schools also reported that *staff buy-in* was commonly reported as both a key enabler and barrier to implementation of school improvement initiatives. Implications of this finding manifested as two questions:

- How do schools reduce the "perceived costs" associated with explicitly teaching SRL?
- How do schools increase epistemic value about SRL among their middle-leaders', and, potentially their teachers, so that the value outweighs the perceived costs?

In the Conclusions, Recommendations and Implications chapter of this thesis (Chapter 9), I discuss more fully the implications of this finding for future research and practice.

4.8. Summary of Changes in Middle-Leader Knowledge and Beliefs

As a result of my analysis the following propositions are identified regarding a more deliberate and consistent approach to introducing SRL as a whole school endeavour.

Key finding 1

Prior to engagement in a PLC-ER about SRL, middle-leaders' knowledge and beliefs about SRL were underdeveloped and inconsistent with SRL theory. For example, middle-leaders' content and pedagogical content knowledge, while extensive, lacked consistency with extant theory about SRL (refer Section 4.1). Results regarding the quality of middle-leaders' knowledge and beliefs about SRL are similar to results reported of regular classroom teachers in previous studies (Barr & Askell-Williams, 2020a; Dignath & Büttner, 2018; Spruce & Bol, 2015).

In terms of the structure of middle-leaders' knowledge and beliefs, some contradictory beliefs were apparent. For example, middle-leaders reported high epistemic value about SRL (which aligns with SRL theory), but some believed that SRL is the result of innate ability (which does not align with SRL theory)(refer Section 4.3). This inconsistency of beliefs has been argued by Lombaerts et al. (2009) as "making it difficult to determine how particular beliefs influence instruction" (p. 89). However, like Vosniadou et al. (2020), I was less interested in a single belief, and more interested in how knowledge and beliefs functioned and changed as a sub-system of middle-leaders' epistemic cognition for teaching about SRL.

Key finding 2

In conjunction with the PLC-ER about SRL, middle-leaders substantially improved the quality of their knowledge and beliefs about SRL over time. For example, improvements occurred in

quality of middle-leaders' content knowledge, pedagogical content knowledge and epistemic ideals about SRL (see Sections 4.1 and 4.4). Improvement in quality of epistemic ideals is notable as concerns have been raised about low quality epistemic ideals and knowledge about assessing student's SRL (Callan & Shim, 2019; Michalsky, 2017). It is important to note that individual participant variation existed in the extent and direction of change for numerous factors (e.g., epistemic ideals), but this was not surprising as individual differences have been acknowledged by other researchers (Archer, 2003; Kerwer & Rosman, 2020; Siegler, 2006) and is consistent with the conceptualisation of educators as agents within a Complex Adaptive System (Rosas, 2017).

Perhaps of greater interest is that whether middle-leaders are viewed as individuals or as a group, their knowledge and belief systems achieved greater alignment with SRL theory and research *following* their involvement in a PLC-ER about SRL. This is evidence that middle-leaders' knowledge and beliefs about SRL are an interrelated set – a system (Lawson et al., 2018; Vosniadou et al., 2020).

5. RQ2: CHANGES IN MIDDLE-LEADER EPISTEMIC REFLEXIVITY

This chapter reports results related to my second set of research questions, namely:

- (RQ2a.) Does middle-leaders' epistemic reflexivity about SRL change in response to a PLC ER about SRL?
- (RQ2b.) If yes, what is the nature of the changes in middle leaders' epistemic reflexivity about SRL in response to a PLC-ER about SRL?
- (RQ2c.) Are the changes in middle leaders' epistemic reflexivity about SRL in response to a PLC ER about sustained over time?

To answer my second set of research questions and evaluate related hypotheses, I collected and analysed school middle-leaders' text segments from think-aloud transcripts (refer 3.7.5). The analysis of the think-aloud transcripts revealed that the discernment moment (the logging of concerns) was not apparent, but only the deliberation and decision moments were. For this reason, insights regarding changes in middle-leaders' epistemic reflexivity are limited by the scope of the think-alouds. This is discussed as a limitation in Chapter 10. Results are reported and discussed in the following sections.

These sections show that my hypotheses related to changes in middle-leaders' epistemic reflexivity about SRL were *supported*, in that:

- (H2a.) Middle leaders' epistemic reflexivity about SRL changed in response to a PLC ER about SRL.
- (H2b.) Changes in middle leaders' epistemic reflexivity were qualitative and quantitative (i.e., path of change), slow (i.e., rate of change), domain-specific (i.e., breadth of change), substantially varied across similar tasks and middle leaders (i.e., variability of change) and were in response to a PLC-ER about SRL (i.e., source of change).
- (H2c.) Changes in middle leaders' epistemic reflexivity about SRL were sustained 9-months after the conclusion of the PLC ER about SRL.

5.1. Changes in Middle-Leader Deliberation Moment of Epistemic Reflexivity

Changes in middle-leaders' *deliberation* moment of epistemic reflexivity about SRL were measured using coded text segments from middle-leaders' think-aloud transcripts. Text segments were coded for quality using the quality framework introduced at Table 3.15.

The mean of combined quality dimension scores for middle-leaders' text segments in the deliberation moment of epistemic reflexivity are reported in Table 5.1. These means include:

pre-intervention (Week 0), immediate post-intervention (Week 12), during intervention (Week 2-8) and long-term post-intervention (Week 52), difference between pre-intervention and immediate post-intervention (Week 0 and Week 12) and difference between pre-intervention and long-term post-intervention (Week 0 and Week 52).

Table 5.1. Mean quality scores for middle-leader deliberation moment of epistemic reflexivity

	Mean							Change scores	
Participant ID	**Week 0 (n = 16)**	**Week 2 (n = 14)**	**Week 4 (n = 11)**	**Week 6 (n = 9)**	**Week 8 (n = 7)**	**Week 12 (n = 7)**	**Week 52 (n = 6)**	**Week 12 minus Week 0**	**Week 52 minus Week 0**
ML1	1.00	2.17	-	-	-	3.00	-	2.00	-
ML2	1.00	3.00	2.50	3.17	2.33	3.67	4.33	2.67	3.33
ML3	1.00	3.17	-	4.33	-	3.83	2.50	2.83	1.50
ML4	1.00	1.00	1.00	1.50	2.00	2.00	NE	1.00	NE
ML5	1.00	1.00	2.00	2.67	1.33	1.00	1.00	0.00	0.00
ML6	1.00	1.00	-	-	-	-	A	-	A
ML7	1.00	1.00	1.00	2.83	-	-	-	-	-
ML8	1.00	1.00	1.00	2.67	2.00	2.00	1.00	1.00	0.00
ML9	1.00	1.00	1.67	2.50	2.50	2.00	1.83	1.00	1.83
ML10	1.00	1.67	1.00	1.00	1.33	-	1.00	-	0.00
ML11	1.00	1.33	2.33	-	2.33	-	A	-	A
ML12	1.00	-	-	-	-	-	-	-	-
ML13	1.50	1.00	1.50	1.33	-	-	-	-	-
ML14	1.00	-	1.00	W	W	W	W	W	W
ML15	1.00	1.00	1.00	-	-	-	-	-	-
ML16	1.00	1.50	-	-	-	-	NE	-	NE
Total change								9.50	6.66
Mean change								1.50	1.11

'-' = Not completed, NE = No longer employed on site, A = Absent – on leave, W = Withdrawn

Table 5.1 shows that prior to the PLC-ER about SRL at Week 0, all 16 middle-leaders reported very low-quality engagement in the deliberation moment of epistemic reflexivity, with mean quality scores ranging from 1.00 to 1.50. Immediately after the PLC-ER about SRL at Week 12, six of the seven middle-leaders who recorded immediate post-intervention thinking-aloud (86%) indicated improvements in their engagement in the deliberation moment of epistemic reflexivity about SRL, with an overall *increase* in the quality change (mean change 1.50). Nine months after the PLC-ER about SRL at Week 52, three of the six middle-leaders who recorded long-term post-intervention think-aloud protocols (50%) showed an increase in the quality of their engagement in the deliberation moment over that of Week 0, with an overall *increase* in quality change (mean change 1.11). However only two showed an increase over Week 12, while one showed a decrease over Week 12.

A non-parametric Wilcoxon Signed-Ranks Tests was calculated on matched middle-leaders' (n=7) quality scores for their engagement in the deliberation moment of epistemic reflexivity about SRL and indicated an *increase* in middle-leaders' deliberation about SRL from Week 0 (*Median* = 1.00) to Week 12 (*Median* = 2.00). This result was *statistically significant*, z = -2.226, p = 0.026, and it showed a medium effect size of *r* = -0.46. Statistical measures were not conducted with Week 52 scores due to low sample sizes caused by participant attrition.

Table 5.1 reported the individual middle-leaders' mean quality scores for deliberation over time. To consider the more nuanced changes between quality dimensions (e.g., extent, well-foundedness), I have reported the means for each quality dimension of middle-leaders' text segments in Figure 5.1.

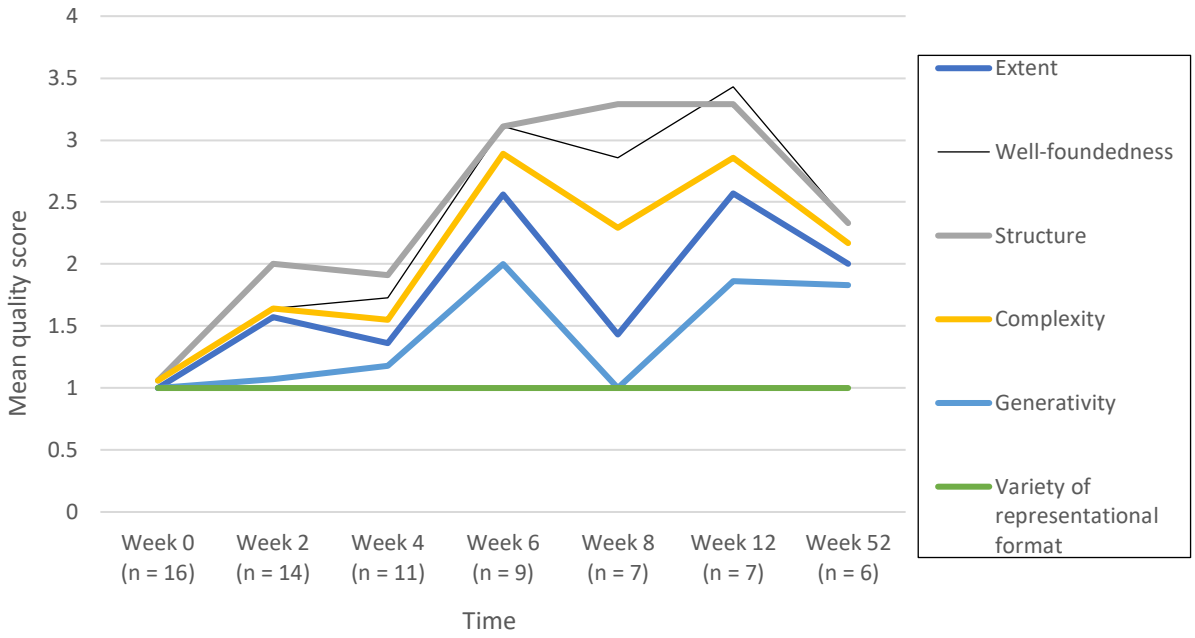

Figure 5.1. Means for quality dimensions of middle-leader deliberation

Figure 5.1 demonstrates that at Week 0, middle-leaders' engagement in deliberation was of relatively low quality, that is, very few statements were recorded that indicated any form of consideration about SRL knowledge in their lesson planning. For example, prior to the PLC-ER at Week 0, ML8 made vague statements that she would know if students had achieved a deeper knowledge about SRL if "they [were] keen to share their knowledge with the class" or if "they showed awareness of their development in their individual studio process". However, over the course of the PLC-ER about SRL and beyond, the quality of middle-leaders' deliberation increased across multiple dimensions of quality (extent, well-foundedness, structure, complexity and generativity) and tended to reflect the participants developing knowledge about SRL. For example, ML8 stated that she would know based on an "open discussion with students about their understanding of and capacity for SRL strategies". Further examples of middle-leaders' text segments about consideration of epistemic matters about SRL are documented in the Coding Manual at Appendix O.

A similar pattern occurred in the quality dimension of *variety of representational format*, in that middle-leaders' coded text segments did not demonstrate different representations. Interestingly, during the PLC-ER about SRL at Week 8, there was a noticeable dip in the quality of the responses recorded, although it is unclear why this occurred.

Engaging in deliberation about different epistemic matters has been advocated by researchers in the field of epistemic cognition (Feucht et al., 2017; Lunn Brownlee et al., 2017; Lunn Brownlee et al., 2019). The improvements noted in Table 5.1 and Figure 5.1 provide evidence for the success of the PLC-ER about SRL.

5.2. Changes in Middle-Leader Decision Moment of Epistemic Reflexivity

Changes in middle-leaders' decision moment of epistemic reflexivity (i.e., setting of epistemic aims and selection of reliable processes) about SRL were measured using text segments from middle-leaders' think-aloud transcripts. Text segments were coded for quality using the quality framework introduced at Table 3.15.

5.2.1. Changes in decisions: Setting of epistemic aims

Mean quality scores for middle-leaders' text segments in the decision moment of epistemic reflexivity are reported in Table 5.2. These means include: pre-intervention (Week 0), immediate post-intervention (Week 12), during intervention (Week 2-8) and long-term post-intervention (Week 52), difference between pre-intervention and immediate post-intervention (Week 0 and Week 12) and difference between pre-intervention and long-term post-intervention (Week 0 and Week 52).

Table 5.2. Mean quality scores for middle-leader setting of epistemic aims

	Mean							Change scores	
Participant ID	Week 0 (n = 16)	Week 2 (n = 14)	Week 4 (n = 11)	Week 6 (n = 9)	Week 8 (n = 7)	Week 12 (n = 7)	Week 52 (n = 6)	Week 12 minus Week 0	Week 52 minus Week 0
ML1	1.50	2.00	-	-	-	2.00	-	0.50	-
ML2	1.17	1.33	3.33	2.17	2.33	3.83	2.67	2.66	1.50
ML3	1.00	2.00	-	2.00	-	2.17	2.50	1.17	1.50
ML4	1.00	1.00	1.00	1.33	1.50	1.67	NE	0.67	NE
ML5	1.00	1.33	1.50	2.83	2.00	1.00	1.00	0.00	0.00
ML6	1.00	1.00	-	-	-	-	A	-	A
ML7	1.00	1.00	1.17	1.50	-	-	-	-	-
ML8	1.00	1.00	1.00	2.17	1.67	2.50	1.00	1.50	0.00
ML9	1.00	1.50	1.83	2.83	2.33	1.50	2.00	0.50	1.00
ML10	1.00	1.67	1.00	1.00	1.33	-	1.00	-	0.00
ML11	1.00	2.00	1.83	-	2.17	-	A	-	A
ML12	1.00	-	-	-	-	-	-	-	-
ML13	1.33	2.17	1.83	2.67	-	-	-	-	-
ML14	1.00	-	1.00	W	W	W	W	W	W
ML15	1.00	1.00	1.00	-	-	-	-	-	-
ML16	1.00	1.17	-	-	-	-	-	-	NE
Total change								7.00	4.00
Mean change								1.00	0.67

'-' = Not completed, NE = No longer employed on site, A = Absent – on leave, W = Withdrawn

Table 5.2 shows that prior to the PLC-ER about SRL at Week 0, all 16 middle-leaders reported low-quality engagement in the decision moment of epistemic reflexivity regarding setting of epistemic aims about SRL. Indeed, middle-leaders rarely explicitly stated their epistemic aims about SRL and even when they did, the "epistemic" nature of these aims was not always clear. Instead, epistemic aims about SRL were often underlying teachers' statements related to their lesson planning.

For example, participant ML2 made the statement "so what I'm hoping for is using the beep strategy [i.e., explicitly prompting a self-monitoring strategy] today will help the girls to maintain their focus during that time". This can be understood as: "to [explicitly] support students to develop their metacognitive knowledge about self-monitoring". Another example is "my SRL outcome will be for students to evaluate their presentation skills via peer feedback that they're going to give to each other and then to use that feedback to set goals for themselves for presentations in the future" (ML4). This statement can be loosely translated as an epistemic aim about SRL as: "to develop students' SRL knowledge related to resource management strategies and goal-setting". Further examples of middle-leaders' text segments about their decisions (i.e., setting of epistemic aims) about SRL are also documented in the Coding Manual at Appendix O.

Prior to the PLC-ER at Week 0, middle-leaders may not have possessed a sufficient knowledge base about SRL, possessed the language to appropriately construct epistemic aims about SRL for their students, or may have chosen to represent their epistemic aims in different ways.

Table 5.2 also shows that immediately after the PLC-ER about SRL at Week 12, six of the remaining seven participating middle-leaders (86%) indicated improvements in their engagement in the decision of setting epistemic aims about SRL, with an overall *increase* in the quality change (mean change 1.00). This suggests that the PLC-ER may have acted as a prompt to engage middle-leaders in the setting of epistemic aims about SRL. Nine months after the PLC-ER about SRL at Week 52, only three of remaining six participating middle-leaders (50%) continued to show improvement in the quality of their engagement in the deliberation moment, with an overall *increase* in quality change (mean change 0.67).

A non-parametric Wilcoxon Signed-Ranks Tests was calculated on matched middle-leaders' (n=7) quality scores for their *decision* regarding setting of epistemic aims and indicated an increase from Week 0 (*Median* = 1.00) to Week 12 (*Median* = 2.00). This result was *statistically significant*, z = -2.207, p = 0.027, and it showed a medium effect size of r = -0.46. Statistical measures were not conducted with Week 52 scores due to low sample sizes caused by participant attrition.

Table 5.2 reported the middle-leaders' mean quality scores for the decision of setting epistemic aims about SRL over time. To consider the more nuanced changes between quality dimensions (e.g., extent, well-foundedness), I have reported the means for each quality dimension of middle-leaders' text segments in Figure 5.2.

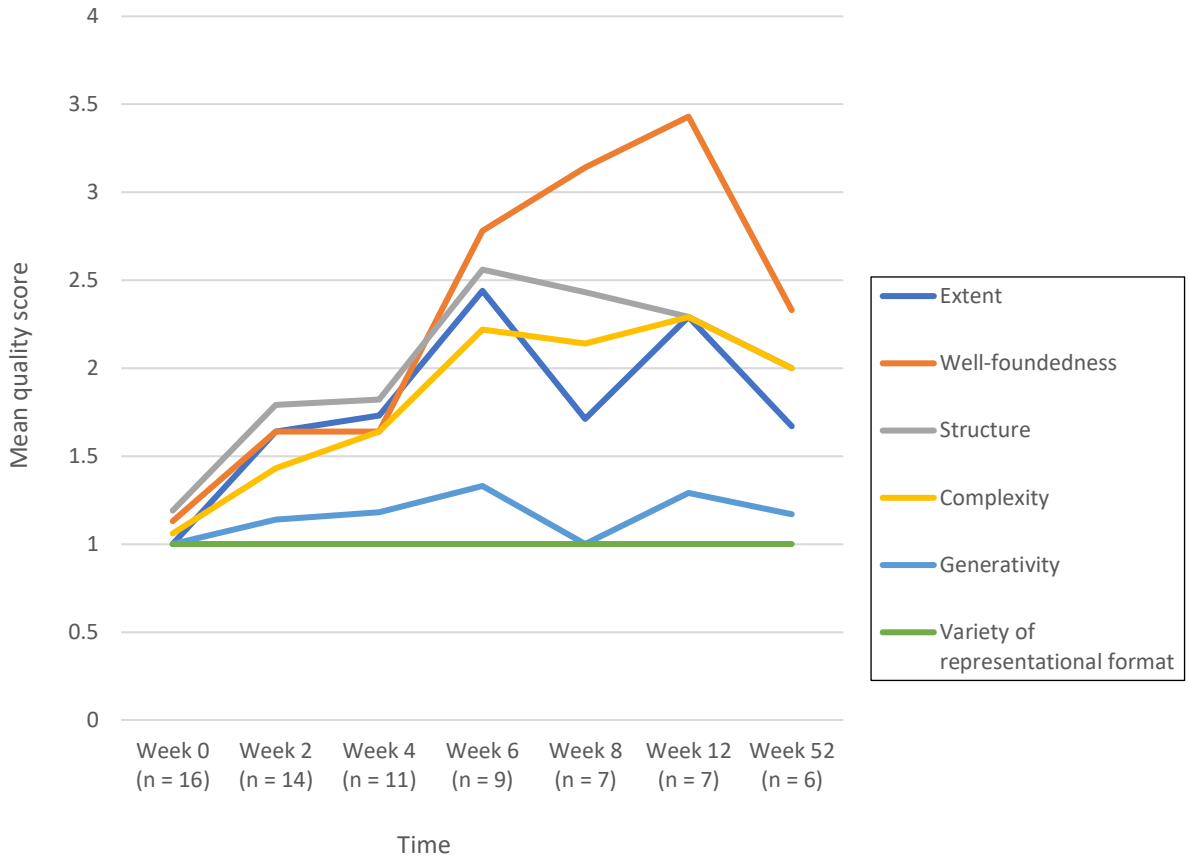

Figure 5.2. Means for quality dimensions of middle-leader setting of epistemic aims

Figure 5.2 indicates the prior to participation in the PLC-ER about SRL (Week 0), middle-leaders engaged in very few decisions regarding the explicit teaching of SRL strategies with mean scores around 1. Over the course of the PLC-ER about SRL (between Weeks 0 and 12), there was a substantial increase in mean values (most notably the dimension of well-foundedness), indicating an increase in quality of middle-leaders' epistemic aims about SRL.

Increases in school middle-leaders' mean values (representing their epistemic aims) can be seen between Week 0 and Week 52 (9-months after the PLC-ER about SRL), although these increases are less than at Week 12. This is actually a positive outcome for the PLC-ER about SRL. The value middle-leaders placed on explicit teaching of SRL strategies was higher at the end of the PLC-ER than afterwards, suggesting that the PLC-ER had a positive effect on middle-leaders' epistemic value about SRL.

This finding represents the *decision* moment in the school middle-leaders' internal conversation of epistemic reflexivity (refer Section 2.5.2), suggesting that middle-leaders had first listed teaching SRL in the *discernment* moment, *deliberated* about SRL and *decided* to teach SRL.

5.2.2. Changes in decisions: Selection of reliable processes

Thus far, in this sub-section, I have considered the quality changes that emerged in middle-leaders' decisions for setting of epistemic aims about SRL. To achieve a better understanding of the changes in middle-leaders' decisions about SRL, I will now consider the changes in their decisions about the selection of reliable processes.

Mean quality scores for middle-leaders' text segments in the decision moment of epistemic reflexivity are reported in Table 5.3. These means include: pre-intervention (Week 0), immediate post-intervention (Week 12), during intervention (Week 2-8) and long-term post-intervention (Week 52), difference between pre-intervention and immediate post-intervention (Week 0 and Week 12) and difference between pre-intervention and long-term post-intervention (Week 0 and Week 52).

Table 5.3. Mean quality scores for middle-leader selection of reliable processes

	Mean							Change scores	
Participant ID	**Week 0 (n = 16)**	**Week 2 (n = 14)**	**Week 4 (n = 11)**	**Week 6 (n = 9)**	**Week 8 (n = 7)**	**Week 12 (n = 7)**	**Week 52 (n = 6)**	**Week 12 minus Week 0**	**Week 52 minus Week 0**
ML1	1.67	2.67	-	-	-	3.67	-	2.00	-
ML2	1.17	1.50	3.67	2.67	3.33	3.83	3.50	2.66	2.33
ML3	1.00	3.33	-	3.67	-	3.83	2.83	2.83	1.83
ML4	1.00	2.00	3.17	2.17	3.17	2.50	NE	1.50	NE
ML5	1.00	1.00	3.67	1.67	1.33	1.00	1.00	0.00	0.00
ML6	1.00	1.00	-	-	-	-	A	-	A
ML7	1.00	1.00	1.17	1.33	-	-	-	-	-
ML8	1.00	2.00	1.00	2.83	1.67	1.00	1.00	0.00	0.00
ML9	1.00	2.50	1.50	3.00	2.33	2.50	1.00	1.50	0.00
ML10	1.00	1.50	1.00	1.00	2.50	-	1.00	-	0.00
ML11	1.00	1.00	2.00	-	2.33	-	A	-	A
ML12	1.00	-	-	-	-	-	-	-	-
ML13	2.33	1.67	3.00	2.67	-	-	-	-	-
ML14	1.00	-	1.00	W	W	W	W	W	W
ML15	1.00	1.00	1.00	-	-	-	-	-	-
ML16	1.00	1.33	-	-	-	-	NE	-	NE
Total change								10.49	4.16
Mean change								1.50	0.69

'-' = Not completed, NE = No longer employed on site, A = Absent – on leave, W = Withdrawn

Table 5.3 shows that prior to the PLC-ER about SRL at Week 0, all the participating middle-leaders reported low-quality engagement in the decision moment of epistemic reflexivity regarding selection of reliable processes. Immediately after the PLC-ER about SRL at Week 12, five of the remaining seven participating middle-leaders (71%) indicated improvements in the quality of their decisions regarding selection of reliable processes, with an overall *increase* in the quality change (mean change 1.50). Nine months after the PLC-ER about SRL at Week 52, only two of the six (33%) remaining participating middle-leaders' showed improvement in the quality of their decision about selection of reliable processes over Week 0, with an overall *increase* in change (mean change 0.69).

A non-parametric Wilcoxon Signed-Ranks Tests was calculated on matched middle-leaders' (n=7) quality scores for their *decision* regarding selection of reliable processes and indicated an *increase* from Week 0 (*Median* = 1.00) to Week 12 (*Median* = 2.50). This result was *statistically significant*, z = -2.032, p = 0.042, and it showed a medium to large effect size of r = -0.42. Statistical measures were not conducted with Week 52 scores due to low sample sizes caused by participant attrition.

Table 5.3 reported the middle-leaders' mean quality scores for the decision of selection of reliable processes about SRL over time. To consider the more nuanced changes between quality dimensions (e.g., extent, well-foundedness), I have visually represented the means for each quality dimension of content knowledge about SRL in Figure 5.3.

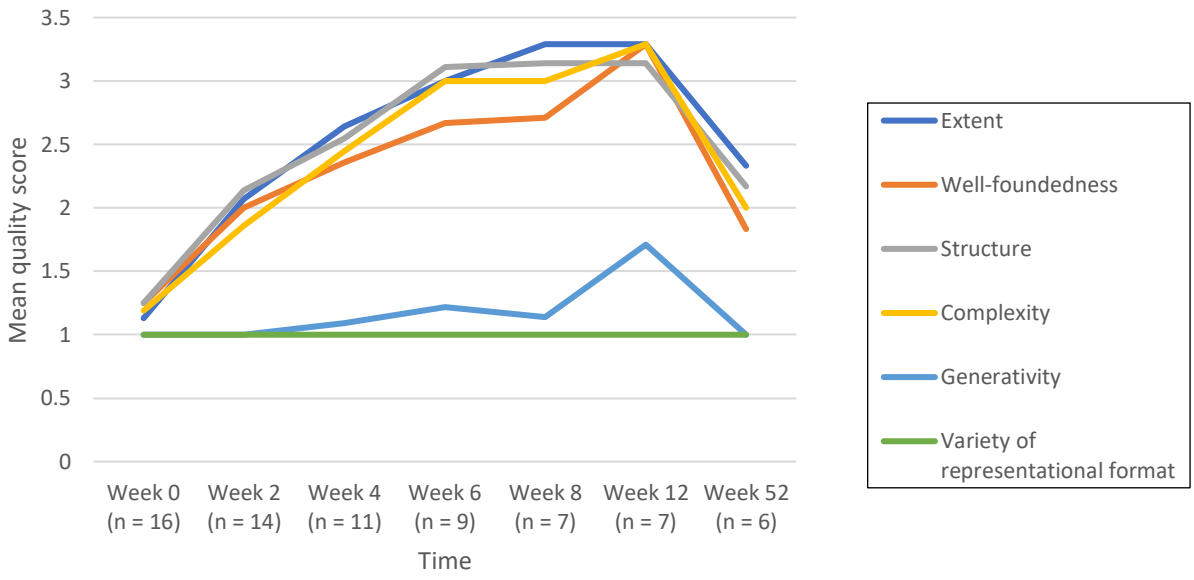

Figure 5.3. Means for quality dimensions of middle-leader selection of reliable processes

Figure 5.3 demonstrates that prior to the PLC-ER about SRL (Week 0), on average, middle-leaders' made surface level statements regarding selection of reliable processes for knowing about SRL. However, twelve middle-leaders didn't make any statements during their

think-aloud transcripts coded to the “selection of reliable processes about SRL” category. The low mean values combined suggests that, prior to the PLC-ER, middle-leaders’ did not engage in the selection of reliable processes or did not know what the reliable processes were to engage them. Reliable processes are required for high-quality epistemic cognition (Chinn et al., 2011; Chinn et al., 2014; Fives et al., 2017), so not possessing knowledge of reliable processes is problematic for the sustainability of school improvement initiatives about SRL.

Over the course of the PLC-ER about SRL, most notably at Week 12, middle-leaders showed improvements in their selection of reliable processes about SRL. However, some participants, namely ML5 and ML8, did not record any statements coded to this area. Nine months after the PLC-ER at Week 52, four of the six remaining participating middle-leaders did not record a statement coded to this area raising the issue that once the PLC-ER was removed, middle-leaders may have regressed in their selection of reliable processes for SRL. ML2 and ML3 (primary school teachers) were the only two middle-leaders to continue to record higher quality selection of reliable process as compared to their data collected prior to the PLC-ER about SRL.

5.3. Summary of Changes in Middle-Leader Epistemic Reflexivity

As a result of my analysis the following propositions are identified regarding a more deliberate and consistent approach to introducing SRL as a whole school endeavour.

Key finding 1

Results reported in this chapter reveal that, prior to engagement in a PLC-ER about SRL, middle-leaders rarely engaged in the *deliberation* and *decision* moments of epistemic reflexivity about SRL, and when they did, quality of engagement was low. As stated in Chapter 1, epistemic reflexivity is a key process underpinning teaching behaviours (Fives et al., 2017; Lunn Brownlee et al., 2017) and middle-leadership plays an important role in the sustainability of school improvement initiatives (Fullan, 2005, 2006; Grootenboer et al., 2019; Harris et al., 2019). It follows that poor engagement by middle-leaders in epistemic reflexivity about SRL may explain the minimal uptake of SRL teaching initiatives currently reported in the literature (Dignath & Büttner, 2018; Dignath-van Ewijk et al., 2013; Hattie & Yates, 2014).

The quality of middle-leaders’ epistemic reflexivity about SRL documented in my study raises concerns about middle-leaders’ capacity not only to teach their own students, but also to engage in instructional leadership about SRL and to support their department/faculty teams.

Key finding 2

Following participation in the PLC-ER about SRL, middle-leaders significantly improved the quality of their epistemic reflexivity about SRL over time. In other words, they not only engaged more in the deliberation and decision moments, but the quality of the reflexive conversation

occurring during these moments reflected greater alignment with SRL theory. Improvements in epistemic reflexivity also indicate that middle-leaders better considered their own motivations, the school's strategic direction, and broader government policy. In other words, middle-leaders' developed as "system thinkers in action", what Fullan (2006) advocated was required for sustainable school improvement. Noted improvements provide evidence that a PLC-ER about SRL is a potential vehicle to improving middle-leaders' epistemic reflexivity about SRL, and therefore, the uptake of SRL teaching initiatives in schools.

6. RQ3: CHANGES IN MIDDLE-LEADER TEACHING PRACTICE

This chapter reports results related to my third set of research questions, namely:

- (RQ3a.) Does middle-leaders' teaching practice about SRL change in response to a PLC ER about SRL?
- (RQ3b.) If yes, what is the nature of the changes in middle leaders' teaching practice about SRL in response to a PLC-ER about SRL?
- (RQ3c.) Are the changes in middle leaders' teaching practice about SRL in response to a PLC ER about SRL sustained over time?

To answer my third set of research questions and evaluate related hypotheses, I collected and analysed 75 video-recordings of middle-leaders' lessons (refer 3.7.6). Video recorded lesson observations were coded using the ATES coding instrument (Dignath-van Ewijk et al., 2013) discussed at 3.8.3. Results for eight middle-leaders, those matched from Week 0 to Week 12, are reported and discussed in the following sections.

These sections show that my hypotheses related to changes in middle-leaders' teaching practice about SRL were *partially supported*, in that:

- (H3a.) Middle leaders' teaching practice about SRL changed in response to a PLC ER about SRL.
- (H3b.) Changes in middle leaders' teaching practice about SRL in response to a PLC ER about SRL were qualitative and quantitative (i.e., path of change), slow (i.e., rate of change), domain-specific (i.e., breadth of change), substantially varied across similar tasks and middle leaders (i.e., variability of change) and were in response to a middle leaders' PLC-ER about SRL (i.e., source of change).
- (H3c.) Changes in middle leaders' teaching practice about SRL varied 9-months after the conclusion of the PLC ER about SRL, and sustained change was unable to be determined due to low sample sizes caused by participant attrition.

6.1. Changes in Explicit Teaching of Motivational Strategies

Number of minutes that middle-leaders matched from Week 0 to Week 12 spent explicitly teaching motivational strategies are reported in Figure 6.1. Number of minutes include: pre-

intervention (Week 0), immediate post-intervention (Week 12), during intervention (Week 2-8) and long-term post-intervention (Week 52).

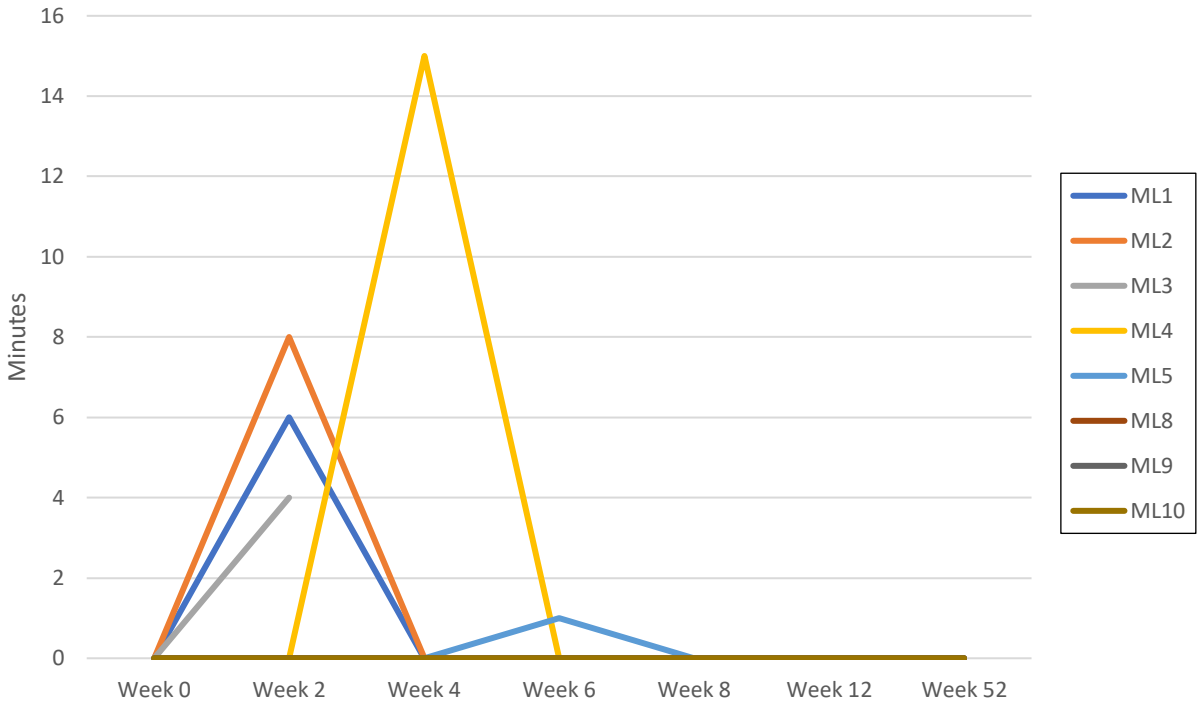

Figure 6.1. Time middle-leaders spent explicitly teaching motivational strategies

Figure 6.1 shows that prior to the PLC-ER about SRL at Week 0, none of the eight middle-leaders spent time explicitly teaching motivational strategies for SRL (0%). Immediately after the PLC-ER about SRL at Week 12, the middle-leaders showed *no change* in the time they dedicated to explicitly teaching motivational strategies for SRL. Nine months after the PLC-ER about SRL at Week 52, the remaining six participating middle-leaders' showed *no change* in the time spent explicitly teaching motivational strategies for SRL. The lack of change in number of minutes that middle-leaders spent explicitly teaching motivational strategies for SRL was expected given the PLC-ER about SRL placed greater emphasis on metacognitive strategies for SRL over motivational strategies for SRL.

Closer analysis of matched middle-leaders' time spent explicitly teaching motivational strategies (refer Figure 6.1) indicated that middle-leaders sporadically engaged in teaching of motivational strategies. For example, at Week 2, all the primary school middle-leaders (ML1, ML2 and ML3) spent 4-8 minutes explicitly teaching motivational strategies to their students. At Week 4, ML4 spent a considerable amount of time (15 minutes) during their lesson explicitly teaching motivational strategies, while at Week 6, ML5 spent 1 minute. Implications of the variation in middle-leaders' time spent on explicitly teaching motivational strategies is further discussed in the Conclusions chapter at section 9.1.3.

6.2. Changes in Explicit Teaching of Cognitive Strategies

Number of minutes that middle-leaders, matched from Week 0 to Week 12 (n=8), spent explicitly teaching cognitive strategies are reported in Figure 6.2. Number of minutes include: pre-intervention (Week 0), immediate post-intervention (Week 12), during intervention (Week 2-8) and long-term post-intervention.

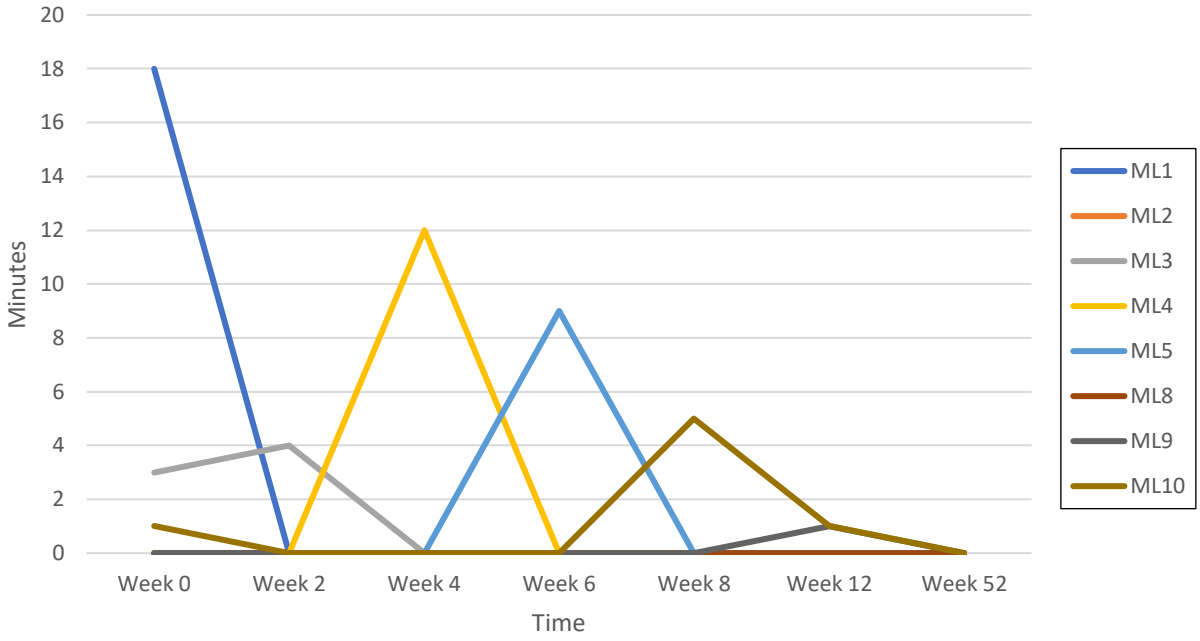

Figure 6.2. Time middle-leaders spent explicitly teaching cognitive strategies

Figure 6.2 shows that prior to the PLC-ER about SRL at Week 0, three (37.5%) of the eight middle-leaders spent time explicitly teaching cognitive strategies for SRL, with ML1 spending 18 minutes teaching cognitive strategies in a Week 0 lesson observation. Immediately after the PLC-ER about SRL at Week 12, two of the eight middle-leaders spent time explicitly teaching cognitive strategies for SRL (25%), with an overall *decrease* in time spent explicitly teaching cognitive strategies. Nine months after the PLC-ER about SRL at Week 52, none (0%) of the remaining six participating middle-leaders' were recorded spending any time explicitly teaching cognitive strategies for SRL, with an overall *decrease* in time spent explicit teaching cognitive strategies.

To evaluate the significance of observed decreases, a non-parametric Wilcoxon Signed-Ranks Tests was calculated for matched middle-leaders' (n=8) time spent explicitly teaching cognitive strategies for SRL and indicated *no change* in middle-leaders' time spent explicitly teaching cognitive strategies for SRL from Week 0 to Week 12. Statistical measures were not conducted with Week 52 scores due to low sample sizes caused by participant attrition.

Similar to the minutes recorded for the explicit teaching of *motivational strategies*, number of minutes that middle-leaders' spent explicitly teaching *cognitive strategies* substantially varied

between individual teacher and lesson. For example, as previously stated, at Week 0, ML1 spent 18 minutes explicitly teaching *cognitive strategies*. At Week 4, ML4 spent 12 minutes, while at Week 6, ML5 spent 9 minutes. The variation in number of minutes spent explicitly teaching SRL strategies might be explained by the quality of teachers' knowledge and beliefs about SRL, as has been a common argument in the field of teachers' thinking about SRL (Askell-Williams et al., 2019; Dignath-van Ewijk & van der Werf, 2012). However, this does not explain why a middle-leader like ML1, who spent 18 minutes and would be deemed knowledgeable about SRL, didn't record any minutes in future lessons. It is possible that middle-leaders felt they had done enough their class in regards to developing SRL. Another explanation is that lesson context plays a critical role in whether middle-leaders and teachers engage in the explicit teaching of SRL strategies (discussed further at 10.1.2): certain lessons (e.g., topics, chosen activities) lend themselves to explicit teaching of cognitive strategies for SRL. It is important to note once again that the focus of the PLC-ER about SRL was on the metacognitive strategies for SRL.

6.3. Changes in Explicit Teaching of Metacognitive Strategies

The number of minutes that middle-leaders, matched from Week 0 to Week 12 (n=8), spent explicitly teaching metacognitive strategies are reported in Figure 6.3. Number of minutes include: pre-intervention (Week 0), immediate post-intervention (Week 12), during intervention (Week 2-8) and long-term post-intervention.

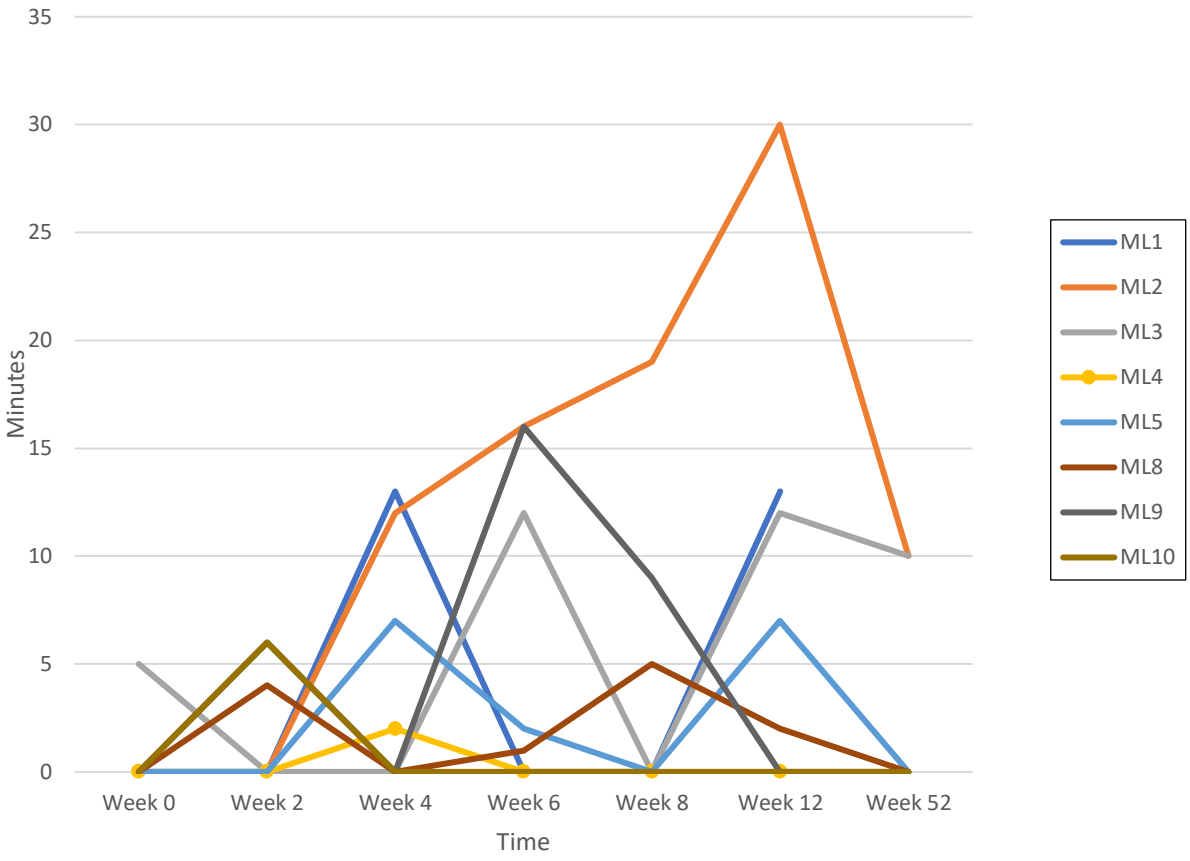

Figure 6.3. Time matched middle-leaders spent explicitly teaching metacognitive strategies

Figure 6.3 shows that prior to the PLC-ER about SRL at Week 0, one of eight middle-leaders (12.5%) spent time explicitly teaching metacognitive strategies for SRL. A low amount of time explicitly teaching SRL strategies is consistent with previous research (Dignath & Büttner, 2018; Hattie & Yates, 2014).

Immediately after the PLC-ER at Week 12, six of the eight middle-leaders (75%) spent time explicitly teaching metacognitive strategies for SRL. There was an *increase* in time spent explicitly teaching metacognitive strategies, an expected increase given the focus of the PLC-ER on metacognitive strategies for SRL. As stated in Section 1.5, there is consensus that the explicit teaching of SRL strategies can support students' SRL. The increases in time noted in middle-leaders' teaching practice are promising for the implementation of SRL teaching initiatives in schools and support a PLC-ER about SRL as a functional solution to the current theory-practice gap (discussed further in Section 9.1.2).

Nine months after the PLC-ER about SRL at Week 52, two of the remaining six middle-leaders' were recorded spending time explicitly teaching metacognitive strategies for SRL (33%). From the perspective of sustainability, this result demonstrates that it is possible for middle-leaders to continue to demonstrate improvements in their teaching practice about SRL well beyond the formal implementation period of the PLC-ER about SRL. However, the

diminishing numbers of middle-leaders engaged in explicit teaching highlights the need to consider supportive structures that promote distal changes. Implications of this finding are elaborated further in the Conclusions Chapter at 9.1.4.

Similar to the variation that occurred for the explicit teaching of motivational and cognitive strategies, Figure 6.3 also demonstrates that there was variation between the middle-leaders in the number of minutes spent explicitly teaching metacognitive strategies. For example, ML2 was a primary school middle-leader and recorded a higher number of minutes spent explicitly teaching SRL strategies than his or her secondary middle-leader counterparts. This pattern of primary school middle-leaders (ML1, ML2 and ML3) recording higher number of minutes compared to secondary school middle-leaders (ML4, ML5, ML8, ML9 and ML10) also appeared at other points over time, indicating that these primary school middle-leaders may have responded more positively to a PLC-ER about SRL than the secondary school middle-leaders. Additionally, Figure 6.3 indicates that each middle-leader themselves varied in the number of minutes spent explicit teaching SRL strategies over time, suggesting that explicit teaching of SRL strategies may be lesson dependent. This has considerable implications for interpretation of results reported in the current and future research and is discussed at 10.1.2.

A non-parametric Wilcoxon Signed-Ranks Tests was calculated on matched middle-leaders' (n=8) time spent explicitly teaching metacognitive strategies for SRL and indicated an *increase* in middle-leaders' time spent explicitly teaching metacognitive strategies for SRL from Week 0 (*Median* = 0.00) to Week 12 (*Median* = 2.00). This result was *statistically significant*, z = -2.032, p = .042, and it showed a medium effect size of *r* = -0.40. Statistical measures were not conducted with Week 52 scores due to low sample sizes caused by participant attrition.

6.4. Changes in Explicit Teaching of All SRL Strategies

Up until now, I have reported middle-leaders' number of minutes spent explicitly teaching different categories of SRL strategies, namely *motivational, cognitive* and *metacognitive strategies*. To consider the more nuanced changes between the explicit teaching of motivational, cognitive and metacognitive strategies, I have reported the mean number of minutes spent for each strategy category about SRL in Figure 6.4. Mean number of minutes include: pre-intervention (Week 0), immediate post-intervention (Week 12), during intervention (Week 2-8) and long-term post-intervention.

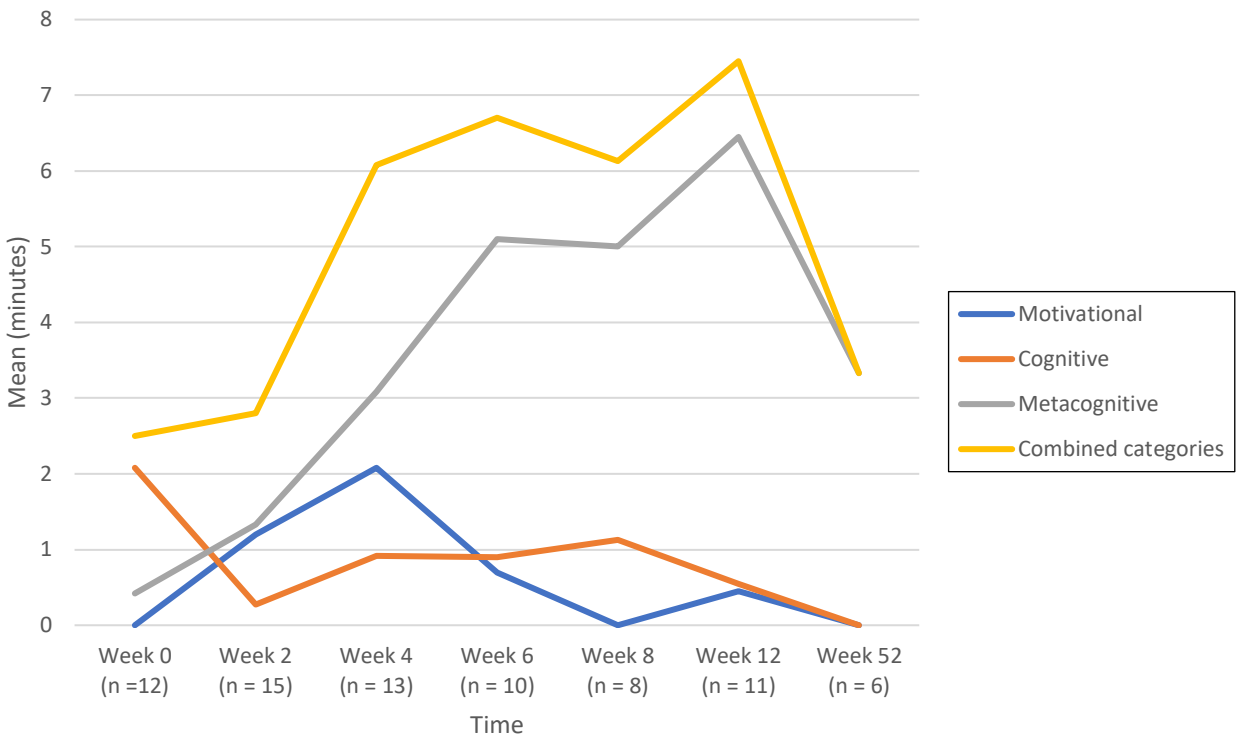

Figure 6.4. Means for middle-leader teaching of different SRL strategy categories

In Figure 6.4, the *combined categories* values at Week 0 show that on average middle-leaders only spent 2.50 minutes explicitly teaching SRL strategies, equivalent to 5% of a 45-minute lesson. This is similar to a finding reported by Hattie and Yates (2014) in which regular classroom teachers spent only 5% of a lesson focussed on developing students' learning strategies. Furthermore, the finding of 2.50 minutes is almost identical to that reported by Dignath and Büttner (2018), who reported that only one of the secondary school teachers in their sample engaged in explicit strategy instruction, devoting just 2.43 minutes to it. Furthermore, in Figure 6.4 the mean values at Week 0 indicate that middle-leaders spent a greater amount of time explicitly teaching cognitive strategies than motivational and metacognitive strategies. Again, this is similar to results reported Dignath and Büttner (2018), that teachers seemed to emphasise cognitive strategies over other strategy categories.

From Figure 6.4 it is evident that middle-leaders increased the number of minutes spent explicitly teaching *Metacognitive* strategies while engaged in the PLC-ER about SRL. The increase in time spent on these strategies is perhaps no surprise given the focus of the PLC-ER on metacognitive strategies. At Week 12, middle-leaders show an increase in minutes spent explicitly teaching metacognitive strategies (*Combined* at 7.5 minutes), while at 9-months after the PLC-ER about SRL (Week 52), middle-leaders continued to an increase (*Combined* at 3.5 minutes) over Week 0. One potential explanation of this finding is that the teaching of SRL strategies requires an ongoing prompt, and is further considered in the Conclusions chapter at Section 9.1.4.

Furthermore, there was also substantial diversity in the amount of time middle-leaders spent on different strategy categories. For example, while the lesson of ML1 were very high in cognitive strategy instruction at Week 0, the video recorded lesson 9-months after the PLC-ER (Week 52) did not yield the same level of cognitive strategy instruction. A possible explanation could be that ML1 believed their students already possessed high quality knowledge of the cognitive strategies required to succeed in the topic being taught or that the students were being provided with more opportunity to practice already-learnt strategies (rather than explicitly teaching more). As another example, during and immediately after the PLC-ER, ML2 spent, on average, 17 minutes focusing on metacognitive strategies. Nine months after the PLC-ER, ML2 continued to explicitly teach SRL strategies (10 minutes). Interestingly, prior to the final lesson observation, ML2 verbally commented that they had not spent a lot of time explicitly teaching SRL strategies since the completion of the PLC-ER about SRL (e.g., "without the prompt…you forget to"). This suggests that the 10 minutes spent explicitly teaching SRL strategies at the 9-months after the PLC-ER data collection point may have been a result of the "prompt" returning (i.e., researcher presence). Additionally, it is possible that for teachers (and school middle-leaders) to actively foster SRL in classrooms, that regular prompts need to be embedded in school cultures. Implications of this finding are further discussed at Section 9.1.4.

6.5. Summary of Changes in Middle-Leader Teaching Practice

As a result of my analysis the following propositions are identified regarding a more deliberate and consistent approach to introducing SRL as a whole school endeavour.

Key finding 1

Prior to engagement in a PLC-ER about SRL, middle-leaders spent little time explicitly teaching SRL strategies. This low amount of time is consistent with previous studies that indicate that teachers spend little time explicitly teaching SRL strategies (Dignath & Büttner, 2018; Hattie & Yates, 2014). When middle-leaders did teach SRL, they spent greater time on cognitive strategies rather than other strategy categories, a finding also reported in other studies (Dignath & Büttner, 2018). Given the substantial body of literature supporting the explicit teaching of SRL strategies as an effective method to supporting students' SRL, this is extremely concerning and provides further justification for the present study.

Key finding 2

Middle-leaders' engagement in a PLC-ER about SRL significantly increased the amount of time middle-leaders spend explicitly teaching *metacognitive strategies*. While the lack of explicit teaching of SRL strategies observed in schools has left many researchers confused (Lawson et al., 2018), results reported in this chapter indicate that a PLC-ER about SRL is a functional method to achieving positive changes in teachers' teaching practice about SRL.

Key finding 3

There were substantial variations in time spent explicitly teaching *motivational, cognitive* and *metacognitive strategies for* and *between* middle-leaders over time. This can be explained by the role of educator's epistemic reflexivity about SRL and the importance of lesson context. The variation caused by lesson context is further considered in the Conclusions chapter at section 9.1.3.

Overall summary

Thus far, I have painted a relatively positive picture of the emergent changes that occurred as middle-leaders participated in a PLC-ER about SRL. Based on results, a PLC-ER about SRL can improve the quality of middle-leaders' knowledge and beliefs about SRL as well as their epistemic reflexivity about SRL, suggesting an overall improvement in their epistemic cognition for teaching about SRL. Furthermore, gains were also noted in their subsequent teaching practice about SRL, particularly for the explicit teaching of metacognitive strategies.

In Section 1.3, and drawing on a range of recent literature (Edwards-Groves & Grootenboer, 2019; Grootenboer et al., 2019; Shaked & Schechter, 2016), I argued that school middle-leaders were well-positioned as instructional leaders to support fellow educators and enhance the quality of teaching practice about SRL throughout the school. Therefore, positive changes that emerged in school middle-leaders' epistemic cognition about SRL has the potential to create a ripple effect (of further emergent changes) in other parts of the system (Kauffman, 1995; Schneider & Somers, 2006), such as teachers' beliefs about SRL and students' reported SRL behaviours.

7. RQ4: CHANGES IN TEACHER BELIEFS

An aim of the present study was to investigate whether changes that emerged in middle-leaders' epistemic cognition and subsequent teaching practice about SRL had any flow-on effects to regular classroom teachers' beliefs about SRL. This chapter reports results related to my fourth set of research questions, namely:

- (RQ4a.) Do regular classroom teachers' beliefs about SRL change in response to their middle leaders' PLC-ER about SRL?
- (RQ4b.) If yes, what is the nature of the changes in regular classroom teachers' beliefs about SRL in response to a middle leaders' PLC-ER about SRL?
- (RQ4c.) Are the changes in regular classroom teachers' beliefs about SRL in response to a middle leaders' PLC ER about SRL sustained over time?

To answer my fourth set of research questions and evaluate related hypotheses, I collected and analysed regular classroom teachers' responses to the closed-ended items of the TEC-SRL questionnaire (refer 3.7.2). Results are reported and discussed in the following sections.

I have focussed my discussion at the *group-level for teachers*, and changes that immediately followed the middle-leaders' PLC-ER about SRL, as the limited sample at 9-months after the middle-leaders' PLC-ER about SRL precludes claims about any meaningful change in teachers' beliefs. Additionally, statistical measures were not conducted with teacher data due to low matched participant data caused by participant attrition. Unfortunately, limitations associated with sample size, I was unable to address RQ4c and H4c.

As the following sections show, my hypotheses related to changes in regular classroom teachers' beliefs about SRL were *partially supported*, in that:

- (H4a.) Regular classroom teachers' beliefs about SRL changed in response to a middle leaders' PLC ER about SRL.
- (H4b.) Changes in regular classroom teachers' beliefs about SRL were qualitative and quantitative (i.e., path of change), slow (i.e., rate of change), domain-specific (i.e., breadth of change), substantially varied across similar tasks and teachers (i.e., variability of change) and were in response to a PLC-ER about SRL (i.e., source of change).
- (H4c.) Changes in regular classroom teachers' beliefs about SRL were unable to be determined 9 months after the conclusion of the middle leaders' PLC ER about SRL.

7.1. Changes in Teacher Epistemic Beliefs about SRL

As described in the Method chapter, changes in regular classroom teachers' epistemic beliefs about SRL (source of SRL, SRL as an innate ability, and the structure of SRL) were measured using responses to five TEC-SRL questionnaire closed-ended items, as detailed in the following sections.

7.1.1. Changes in teacher beliefs about source of SRL knowledge

Regular classroom teachers' beliefs about the source of SRL were measured using Likert scale (1-7, 1 = Very untrue; 7 = Very true) responses to two TEC-SRL items:

- **Item 4:** Knowledge of how to self-regulate learning comes from the teacher.
- **Item 5:** Knowledge of how to self-regulate learning comes from a student's own personal construction.

I have reported regular classroom teachers' frequency of agreement (Likert scale responses 5, 6 or 7) to Items 4 and 5 at pre-intervention and immediate post-intervention in Table 7.1.

Table 7.1. Frequency of teachers' Likert scale responses for Items 4 and 5

	Frequency of Likert scale responses (5, 6 and 7)	
Item	**Week 0 (n = 18)**	**Week 12 (n = 11)**
4: Knowledge of how to self-regulate learning comes from the teacher	17 (94%)	10 (91%)
5: Knowledge of how to self-regulate learning comes from a student's own personal construction	16 (89%)	11 (100%)

Table 7.1, Item 4 shows that prior to the middle-leaders' PLC-ER about SRL at Week 0, 17 of the 18 regular classroom teachers who completed the pre-intervention TEC-SRL questionnaire (94%) scored 5 or higher, which indicates a belief that knowledge of how to self-regulate comes from the teacher. Immediately after the middle-leaders' PLC-ER about SRL at Week 12, 10 of the 11 regular classroom teachers who completed the immediate post-intervention TEC-SRL questionnaire (91%) scored 5 or higher, which indicates a belief that knowledge of how to self-regulate comes from the teacher.

Table 7.1, Item 5 shows that prior to the middle-leaders' PLC-ER about SRL at Week 0, 16 of the 18 regular classroom teachers who completed the pre-intervention TEC-SRL questionnaire (89%) scored 5 or higher, indicating a belief that knowledge of how to self-regulate learning comes from a student's own personal construction. Immediately after the middle-leaders' PLC-ER about SRL at Week 12, 11 of the 11 regular classroom teachers who completed the immediate post-intervention TEC-SRL questionnaire (100%) scored 5 or higher,

indicating a belief that knowledge of how to self-regulate learning comes from a student's own personal construction,

Overall, prior to the middle-leaders' PLC-ER about SRL, classroom teachers believed that students' knowledge about SRL was sourced from their teachers *and* from students' own personal construction. This is similar to the results reported earlier at Section 4.2.1 about middle-leaders' beliefs about the source of SRL knowledge: that the source of SRL knowledge is not a simple dichotomy (Buehl & Fives, 2009; Olafson & Schraw, 2006). Little change occurred in these beliefs over time and this is a positive finding as constructivist theories, particularly constructivist-supported beliefs (refer section 2.3.2), are commonly associated with the teaching of SRL in ways that enable students to transform the knowledge presented by teachers into students' own cognitive schema (Kramarski & Michalsky, 2009; Vosniadou et al., 2020).

7.1.2. Changes in teacher beliefs about SRL knowledge as innate

Changes in regular classroom teachers' beliefs about SRL knowledge as an innate ability were measured using Likert scale (1-7, 1 = Very untrue; 7 = Very true) responses to two TEC-SRL items:

- **Item 6:** SRL is a talent students are born with.
- **Item 7:** Students can learn how to be effective self-regulated learners.

I have reported regular classroom teachers' frequency of agreement (Likert scale responses 5, 6 or 7) to Items 6 and 7 at pre-intervention and immediate post-intervention in Table 7.2.

Table 7.2. Frequency of teachers' Likert scale responses for Items 6 and 7

	Frequency of Likert scale responses (5, 6 and 7)	
Item	**Week 0 (n = 18)**	**Week 12 (n = 11)**
6: SRL is a talent students are born with	3 (17%)	2 (18%)
7: Students can learn how to be effective self-regulated learners	18 (100%)	11 (100%)

Table 7.2, Item 6 shows that prior to the middle-leaders' PLC-ER about SRL at Week 0, three of the 18 regular classroom teachers who completed the pre-intervention TEC-SRL questionnaire (17%) scored 3 or lower indicating a belief that SRL is *not* an innate ability. Immediately after the middle-leaders' PLC-ER about SRL at Week 12, two of the 11 regular classroom teachers who completed the immediate post-intervention TEC-SRL questionnaire (18%) scored 3 or lower, indicating a belief that SRL is *not* an innate ability.

Table 7.2, Item 7 shows that prior to the middle-leaders' PLC-ER about SRL at Week 0, all the 18 regular classroom teachers who completed the pre-intervention TEC-SRL questionnaire

(100%) scored 5 or higher, which indicates a belief that students can learn how to self-regulate their learning. Immediately after the middle-leaders' PLC-ER about SRL at Week 12, all the 11 regular classroom teachers who completed the immediate and long-term post-intervention TEC-SRL questionnaire (100%) scored 5 or higher, which indicates a belief that students can learn how to self-regulate their learning.

The finding that classroom teachers typically considered that SRL as learned rather than innate is similar to that reported for middle-leaders and is positive, given studies have reported increased likelihood of explicit teaching of SRL strategies associated with belief that SRL is learned (for example, Dignath-van Ewijk, 2016).

7.1.3. Changes in teacher beliefs about structure of SRL knowledge

Changes in regular classroom teachers' beliefs about the structure of SRL knowledge was measured using Likert scale (1-7, 1 = Very untrue; 7 = Very true) responses to one TEC-SRL item:

- **Item 8:** Knowledge of SRL is equal in complexity to other subjects (e.g., Maths).

I have reported regular classroom teachers' frequency of agreement (Likert scale responses 5, 6 or 7) to Item 8 at pre-intervention and immediate post-intervention in Table 7.3.

Table 7.3. Frequency of teachers' Likert scale responses for Item 8

	Frequency of Likert scale responses (5, 6 and 7)	
Item	**Week 0 (n = 18)**	**Week 12 (n = 11)**
8: Knowledge of SRL is equal in complexity to other subjects (e.g., Maths)	10 (56%)	5 (45%)

Table 7.3 shows that prior to the middle-leaders' PLC-ER about SRL at Week 0, 10 of the 18 regular classroom teachers who completed the pre-intervention TEC-SRL questionnaire (56%) scored 5 or higher, which indicates a belief that the structure of SRL knowledge was equal in complexity to other subjects. Immediately after the middle-leaders' PLC-ER about SRL at Week 12, five of the 11 regular classroom teachers who completed the immediate post-intervention TEC-SRL questionnaire (45%) scored 5 or higher, which indicates a belief that SRL knowledge was equal in complexity to other subjects.

The variation between reported beliefs about SRL as a complex body of knowledge suggests a misalignment for some teachers about the structure of SRL knowledge and SRL theory. Indeed, as Bondy et al. (2007) demonstrated in other domains, without recognition of the domain of SRL as a deeply complex body of knowledge, regular classroom teachers are unlikely to engage in productive teaching and learning behaviours. The finding that regular classroom teachers did not appear to alter their view of the complexity of SRL knowledge

during the school middle-leaders' PLC-ER about SRL, raises questions as to whether the middle-leaders were translating and disseminating their developing knowledge and beliefs about SRL back to the staff in their school faculties.

7.2. Changes in Teacher Epistemic Value about SRL

Changes in regular classroom teachers' epistemic value about SRL was measured using Likert scale (1-7, 1 = Very untrue; 7 = Very true) responses to four TEC-SRL items:

- **Item 9:** When planning a regular lesson, I explicitly set a teaching goal to develop students' knowledge about SRL.
- **Item 10:** It is important to develop students' knowledge about SRL.
- **Item 11:** When planning a regular lesson, I explicitly set a teaching goal to assess students' knowledge about SRL.
- **Item 12:** It is important to assess students' knowledge about SRL.

Mean scores were calculated for Items 9-12 and I have reported regular classroom teachers' frequency of agreement (mean Likert scale responses 5, 6 or 7) to these items at pre-intervention and immediate post-intervention in Table 7.4.

Table 7.4. Frequency of means of teachers' Likert scale responses for Items 9-12

	Frequency of Likert scale responses (5, 6 and 7)	
Item	**Week 0 (n = 18)**	**Week 12 (n = 11)**
9-12: ALL epistemic value items	16 (89%)	9 (82%)

Table 7.4 shows that prior to the middle-leaders' PLC-ER about SRL at Week 0, 16 of the 18 regular classroom teachers who completed the pre-intervention TEC-SRL questionnaire (89%) scored 5 or higher, which indicates epistemic value for teaching SRL. Immediately after the middle-leaders' PLC-ER about SRL at Week 12, 9 of the 11 regular classroom teachers who completed the immediate post-intervention TEC-SRL questionnaire (82%) scored 5 or higher, which indicates epistemic value for teaching SRL knowledge. The continuing high percentage of teachers reporting epistemic value about SRL is a positive finding, as epistemic value can influence teaching and learning behaviours (Chinn & Rinehart, 2016; Fives et al., 2017).

Closer analysis of difference between epistemic value items demonstrated that prior to the middle-leaders' PLC-ER about SRL, regular classroom teachers generally placed value on developing students' SRL knowledge (Items 9 and 10), but this value was not equally evident in regular classroom teachers' self-reported practice (i.e., enacted value; Items 11 and 12). This finding corresponds with previous studies that indicated teachers self-report epistemic value

about SRL, but this is often inconsistent with the time they spend explicitly teaching SRL strategies in classrooms (Dignath & Büttner, 2018; Karlen et al., 2020).

One unanticipated finding is that prior to the middle-leaders' PLC-ER about SRL, when comparing Items 10 and 12, regular classroom teachers placed greater value on *developing* students' knowledge about SRL than *assessing* student knowledge. Effective teaching requires an interplay between ongoing assessment and development of student knowledge (Grigorenko, 2009), so it was expected that both items 10 and 12 would have generated similar scores from participants.

7.3. Changes in Teacher Epistemic Ideals about SRL

Changes in regular classroom teachers' epistemic ideals about SRL were measured using Likert scale (1-7, 1 = Very untrue; 7 = Very true) responses to two TEC-SRL items:

- **Item 15:** I know when students have achieved deeper knowledge about SRL.
- **Item 17:** I use a set of criteria to evaluate whether students have achieved deeper knowledge about SRL.

I have reported regular classroom teachers' frequency of agreement (Likert scale responses 5, 6 or 7) to Items 15 and 17 at pre-intervention and immediate post-intervention in Table 7.5.

Table 7.5. Frequency of teachers' Likert scale responses for Items 15 and 17

	Frequency of Likert scale responses (5, 6 and 7)	
Item	**Week 0 (n = 18)**	**Week 12 (n = 11)**
15: I know when students have achieved deeper knowledge about SRL	13 (72%)	9 (82%)
17: I use a set of criteria to evaluate whether students have achieved deeper knowledge about SRL	4 (22%)	5 (45%)

Table 7.5, Item 15 shows that, prior to the middle-leaders' PLC-ER about SRL at Week 0, 13 of the 18 regular classroom teachers who completed the pre-intervention TEC-SRL questionnaire (72%) scored 5 or higher, which indicates a belief that they knew when students had achieved a deeper knowledge about SRL. Immediately following the middle-leaders' PLC-ER about SRL at Week 12, nine of the 11 regular classroom teachers who completed the immediate post-intervention TEC-SRL questionnaire (82%) scored 5 or higher, which indicates a belief that they knew when their students had achieved deeper knowledge about SRL.

Table 7.5, Item 17 shows that prior to the middle-leaders' PLC-ER about SRL at Week 0, only four of the 18 regular classroom teachers who completed the TEC-SRL questionnaires (22%) scored 5 or higher indicating that they used epistemic ideals to assess students' SRL.

Immediately after the middle-leaders' PLC-ER about SRL at Week 12, only five of the 11 regular classroom teachers who completed the immediate post-intervention TEC-SRL questionnaire (45%) scored 5 or higher indicating that they used epistemic ideals to assess students' SRL.

When contrasting results from Items 15 (teachers reporting knowing that students had developed SRL knowledge) and 17 (teachers *not* using a set of evaluation criteria), the question is raised: How do teachers accurately know when their students have achieved a deeper knowledge about SRL if they do not have a clear and well-thought through criteria to assess such changes? Further research is required and this is considered in Section 10.2.5.

7.4. Changes in Teacher Metacognitive Regulation of Epistemic Cognition for Teaching about SRL

Regular classroom teachers' metacognitive regulation of their epistemic cognition for teaching about SRL was measured using Likert scale (1-7, 1 = Very untrue; 7 = Very true) to 12 TEC-SRL items:

- **Item 19:** I pace myself while I am teaching about SRL in order to have enough time.
- **Item 20:** I ask myself periodically if I meet my teaching goals about SRL while I am teaching.
- **Item 21:** I ask myself how well I have accomplished my teaching goals about SRL once I am finished.
- **Item 22:** I set my specific teaching goals about SRL before I start teaching.
- **Item 23:** I find myself assessing how useful my teaching techniques for SRL are while I am teaching.
- **Item 24:** I ask myself if I could have used different SRL techniques after each teaching experience.
- **Item 25:** I ask myself questions about SRL teaching materials I am going to use.
- **Item 26:** I check regularly to what extent my students comprehend the topic of SRL while I am teaching.
- **Item 27:** After teaching a point about SRL. I ask myself if I'd teach it more effectively next time.
- **Item 28:** I organize my time to best accomplish my teaching goals about SRL.
- **Item 29:** I ask myself questions about how well I am doing while I am teaching about SRL.
- **Item 30:** I ask myself if I have considered all possible SRL techniques after teaching a point.

Mean scores were calculated for Items 19-30 and I have reported regular classroom teachers' frequency of agreement (mean Likert scale responses 5, 6 or 7) to these items at pre-intervention and immediate post-intervention in Table 7.6.

Table 7.6. Frequency of means of teachers' Likert scale responses for Items 19-30

	Frequency of Likert scale responses (5, 6 and 7)	
Item	**Week 0 (n = 18)**	**Week 12 (n = 11)**
19-30: ALL metacognitive regulation items	10 (56%)	8 (73%)

Table 7.6 shows that prior to the middle-leaders' PLC-ER about SRL at Week 0, 10 of the 18 regular classroom teachers who completed the pre-intervention TEC-SRL questionnaire (56%) scored 5 or higher indicating engagement in metacognitive regulation of their epistemic cognition for teaching about SRL. Immediately after the middle-leaders' PLC-ER about SRL at Week 12, eight of the 11 regular classroom teachers who completed the immediate post-intervention TEC-SRL questionnaire (73%) scored 5 or higher indicating engagement in metacognitive regulation: a notable *increase* in frequency of agreement. This is a positive finding given the role of metacognitive regulation in high quality epistemic cognition (Barzilai & Chinn, 2018; Cartiff, Duke, & Greene, 2020; Lunn Brownlee et al., 2019).

7.5. Changes in Teacher Self-Reported Teaching Practice About SRL

Changes in regular classroom teachers' self-reported teaching practice about SRL were measured using Likert scale (1-7, 1 = 0-15%; 2 = 16-30%; 3 = 31-45%; 4 = 46-60%; 5 = 61-75%; 6 = 76-90%; 7 = >90%) responses to four TEC-SRL items:

- **Item 13:** In the past week, how many lessons have you explicitly set a teaching goal to develop students' knowledge about SRL?
- **Item 14:** In the past week, how many lessons have you explicitly set a teaching goal to assess students' knowledge about SRL.
- **Item 33:** Explicitly teaching students about SRL strategies can improve student SRL knowledge. In the past week, how many lessons have you taught students' SRL in this way?
- **Item 36:** Metacognitive prompts (e.g., what is your goal for this task?) can engage students in SRL and provide valuable feedback on how students are self-regulating their learning. In the past week, how many lessons have you incorporated metacognitive prompts in your teaching?

Mean scores were calculated for Items 13, 14, 33 and 36 and I have reported regular classroom teachers' frequency of agreement (mean Likert scale responses 5, 6 or 7) to these items at pre-intervention and immediate post-intervention in Table 7.7.

Table 7.7. Frequency of means of teachers' Likert scale responses for Items 13, 14, 33 and 36

	Frequency of Likert scale responses (5, 6 and 7)	
Item	**Week 0 (n = 18)**	**Week 12 (n = 11)**
13, 14, 33 and 36: ALL self-reported teaching practice about SRL items	4 (22%)	5 (45%)

Table 7.7 shows that prior to the middle-leaders' PLC-ER about SRL at Week 0, four of the 18 regular classroom teachers who completed the pre-intervention TEC-SRL questionnaire (22%) scored 5 (rounded to 5) or higher indicating that they teach about SRL. Immediately following the middle-leaders' PLC-ER about SRL at Week 12, five of the 11 regular classroom teachers who completed the immediate post-intervention TEC-SRL questionnaire (45%) scored 5 (rounded to 5) or higher indicating that they teach about SRL. As argued for middle-leaders, a positive perception about practice can increase teachers' self-efficacy for teaching about SRL (Bandura, 1997, 2000) that, in turn, can influence teaching practice about SRL (Karlen et al., 2020).

7.6. Changes in Teacher Perceived Enablers and Barriers

Changes in regular classroom teachers' perceptions of enablers and barriers about SRL were measured using responses to nine TEC-SRL questionnaire closed-ended items as detailed in the following sections.

7.6.1. Teacher perception of professional development about SRL

Teachers' perceptions of professional development about SRL were measured using Likert scale (1-7, 1 = Very untrue; 7 = Very true) responses to two TEC-SRL items:

- **Item 38:** I have undertaken useful professional development about SRL.
- **Item 39:** Many staff in my school have undertaken useful professional development about SRL.

I have reported regular classroom teachers' frequency of agreement (Likert scale responses 5, 6 or 7) to Items 38 and 39 at pre-intervention and immediate post-intervention in Table 7.8.

Table 7.8. Frequency of teachers' Likert scale responses for Items 38 and 39

Item	Frequency of Likert scale responses (5, 6 and 7)	
	Week 0 (n = 18)	**Week 12 (n = 11)**
38: I have undertaken useful professional development about SRL	3 (17%)	3 (27%)
39: Many staff in my school have undertaken useful professional development about SRL	6 (33%)	5 (45%)

Table 7.8, Item 38 shows that prior to the middle-leaders' PLC-ER about SRL at Week 0, three of 18 regular classroom teachers who completed the pre-intervention TEC-SRL questionnaire (20%) scored 5 or higher indicating a belief that they had undertaken useful professional education about SRL. Immediately after the middle-leaders' PLC-ER about SRL at Week 12, three of 11 regular classroom teachers who completed the immediate post-intervention TEC-SRL questionnaire (27%) scored 5 or higher indicating a belief that that they had undertaken useful professional development about SRL. A lack of training, or perception of useful training, has been documented as a barrier to sustainability of school improvement initiatives (Turri et al., 2016), so findings raise concerns for the implementation of SRL teaching initiatives in schools.

Table 7.8, Item 39 shows that prior to the middle-leaders' PLC-ER about SRL at Week 0, six of the 18 regular classroom teachers who completed the pre-intervention TEC-SRL questionnaire (33%) scored 5 or higher indicating a belief that many staff had undertaken useful professional education about SRL. Immediately after the middle-leaders' PLC-ER about SRL at Week 12, five of the 11 regular classroom teachers who completed the immediate post-intervention TEC-SRL questionnaire (45%) scored 5 or higher indicating a belief that many staff in their school had undertaken useful professional development about SRL.

7.6.2. Teacher perception of school environment

Regular classroom teachers' perceptions of the school environment about SRL were measured using Likert scale (1-7, 1 = Very untrue; 7 = Very true) responses to five TEC-SRL items:

- **Item 37:** Leadership staff in my school support explicit teaching of SRL.
- **Item 40:** My school regularly reports to staff our progress with developing students' SRL.
- **Item 41:** Promoting students' SRL is included in our school mission statements.
- **Item 42:** Our parent community supports us teaching about SRL.
- **Item 43:** In my school, developing students' knowledge about SRL forms part of the curriculum.

I have reported regular classroom teachers' frequency of agreement (Likert scale responses 5, 6 or 7) to Items 37 and 40-43 at pre-intervention and immediate post-intervention in Table 7.9.

Table 7.9. Frequency of teachers' Likert scale responses for Items 37 and 40-43

Item	Frequency of Likert scale responses (5, 6 and 7)	
	Week 0 (n = 18)	**Week 12 (n = 11)**
37: Leadership staff in my school support explicit teaching of SRL	16 (89%)	8 (73%)
40: My school regularly reports to staff our progress with developing students' SRL	9 (50%)	3 (27%)
41: Promoting students' SRL is included in our school mission statements	10 (56%)	7 (64%)
42: Our parent community supports us teaching about SRL	10 (56%)	7 (64%)
43: In my school, developing students' knowledge about SRL forms part of the curriculum	13 (72%)	11 (100%)

Table 7.9, Item 37 shows that prior to the middle-leaders' PLC-ER about SRL at Week 0, 16 of 18 regular classroom teachers who completed the pre-intervention TEC-SRL questionnaire (89%) scored 5 or higher indicating a belief that leadership staff support the teaching of SRL. De Smul et al. (2018), in their survey study of school and teacher factors that influence implementation of SRL teaching initiatives, reported that school leaders influenced the explicit teaching of SRL strategies. Therefore, regular classroom teachers' perceptions of school leaders being supportive of SRL can, arguably, improve the likelihood of the SRL teaching initiatives being adopted in schools. Immediately after the middle-leaders' PLC-ER about SRL at Week 12, eight of the 11 regular classroom teachers who also completed the immediate post-intervention TEC-SRL questionnaire (73%) scored 5 or higher indicating a belief that leadership staff support the teaching of SRL.

Table 7.9, Item 40 shows that prior to the middle-leaders' PLC-ER about SRL at Week 0, nine of 18 regular classroom teachers who completed the pre-intervention TEC-SRL questionnaire (50%) scored 5 or higher indicating a belief that the school regularly reported to staff progress about SRL. Immediately after the middle-leaders' PLC-ER about SRL at Week 12, three of the 11 regular classroom teachers who completed the immediate post-intervention TEC-SRL questionnaire (27%) scored 5 or higher indicating a belief that the school regularly reported to staff progress about SRL. As stated in Section 4.7, reporting short-term progress/results has been argued as "necessary to build trust with the public or shareholders for longer-term investments" (Fullan, 2006, p. 120) and making progress visible increases

teachers' motivation for implementing the practice (Han & Weiss, 2005), so regular classroom teachers' perceptions that the school was not reporting progress will likely hinder implementation of SRL teaching initiatives.

Table 7.9, Item 41 shows that prior to the middle-leaders' PLC-ER about SRL at Week 0, 10 of 18 regular classroom teachers who completed the pre-intervention TEC-SRL questionnaire (56%) scored 5 or higher indicating a belief that promoting students' SRL was included in the school's mission. This is a positive finding given researchers have documented a school's vision and mission as an enabler for sustainability of school improvement initiative (De Smul et al., 2018; Heirweg et al., 2020; M. James & McCormick, 2009). Interestingly, just seven teachers were uncertain. Immediately after the middle-leaders' PLC-ER about SRL at Week 12, seven of the 11 regular classroom teachers who completed the immediate post-intervention TEC-SRL questionnaire (64%) scored 5 or higher indicating a belief that promoting students' SRL was included in the school's mission. Yet, three teachers were still uncertain. Teachers' uncertainty about whether SRL was included in the school's mission statements suggests that further clarification was required at the school level to ensure that promoting SRL was clearly positioned within the school's mission.

Table 7.9, Item 42 shows that prior to the middle-leaders' PLC-ER about SRL at Week 0, 10 of the 18 regular classroom teachers who completed the pre-intervention TEC-SRL questionnaire (56%) scored 5 or higher indicating a belief that the parent community supported them teaching about SRL. This is a positive finding as a perception of parent community support is likely to enabler the sustainability of school improvement initiatives about SRL (Pinkelman et al., 2015). Immediately after the middle-leaders' PLC-ER about SRL at Week 12, seven of the 11 regular classroom teachers who completed the immediate post-intervention TEC-SRL questionnaire (64%%) scored 5 or higher indicating a belief that the parent community supported them teaching about SRL

Table 7.9, Item 43 shows that prior to the middle-leaders' PLC-ER about SRL at Week 0, 13 of the 18 regular classroom teachers who completed the pre-intervention TEC-SRL questionnaire (72%) scored 5 or higher, which indicates belief that SRL formed part of the curriculum. Immediately following the middle-leaders' PLC-ER about SRL at Week 12, 11 of 11 regular classroom teachers who completed the immediate post-intervention TEC-SRL questionnaire (100%) scored 5 or higher, which indicates belief that SRL formed part of the curriculum. This is a positive finding as teachers responses indicate that they did *not* view SRL as a competing priority or a barrier to implementation (Turri et al., 2016).

7.6.3. Teacher perception of longevity of SRL

Regular classroom teachers' perceptions of the longevity of SRL were measured using Likert scale (1-7, 1 = Very untrue; 7 = Very true) responses to two TEC-SRL items:

- **Item 44:** If the key staff who promote SRL were to leave our school the emphasis on it would probably die out.
- **Item 45:** In truth, SRL is a current fad, that will eventually be replaced by the next 'big thing'.

I have reported regular classroom teachers' frequency of agreement (Likert scale responses 5, 6 or 7) to Items 44 and 45 at pre-intervention and immediate post-intervention in Table 7.10.

Table 7.10. Frequency of teachers' Likert scale responses for Items 44 and 45

	Frequency of Likert scale responses (5, 6 and 7)	
Item	**Week 0 (n = 18)**	**Week 12 (n = 11)**
44: If the key staff who promote SRL were to leave our school the emphasis on it would probably die out	2 (11%)	2 (18%)
45: In truth, SRL is a current fad, that will eventually be replaced by the next 'big thing'	0 (0%)	2 (18%)

Table 7.10, Item 44 shows that prior to the middle-leaders' PLC-ER about SRL at Week 0, two of the 18 regular classroom teachers who completed the pre-intervention TEC-SRL questionnaire (11%) scored 5 or higher, which indicates belief that if key staff who promote SRL were to leave the school, emphasis on SRL teaching would decline. Immediately following the middle-leaders' PLC-ER about SRL at Week 12, two of the 11 regular classroom teachers who completed the immediate post-intervention TEC-SRL questionnaire (18%) scored 5 or higher, which indicates belief that if key staff who promote SRL were to leave the school, emphasis would decline. The low percentage of agreement (responses of 5, 6 or 7) is a positive finding for the sustainability of SRL teaching initiatives as the priority of SRL is not held by a handful of staff, but potentially distributed among teachers.

Table 7.10, Item 45 shows that prior to the middle-leaders' PLC-ER about SRL at Week 0, zero of the 15 regular classroom teachers who completed the pre-intervention TEC-SRL questionnaire (0%) scored 5 or higher, which indicates belief that SRL is a fad that would eventually die out. Immediately following the middle-leaders' PLC-ER about SRL at Week 12, two of the 11 regular classroom teachers who completed the immediate post-intervention TEC-SRL questionnaire (18%) scored 5 or higher, which indicates belief that SRL is a fad that would eventually die out. As stated in Section 4.7, researchers have reported that staff buy in is a key condition for the sustainability of school improvement initiatives (Pinkelman et al., 2015;

Turri et al., 2016). Therefore, if regular classroom teachers view SRL as a temporary innovation or change for the sake of change, then they are unlikely to invest in learning about how they can foster students' knowledge about SRL in the classroom.

7.7. Summary of Teacher Beliefs about SRL

As a result of my analysis the following propositions are identified regarding a more deliberate and consistent approach to introducing SRL as a whole school endeavour.

Key finding 1

Results reveal that prior to the school middle-leaders' PLC-ER about SRL, regular classroom teachers' beliefs about SRL were considerably underdeveloped, a finding consistent with the finding for participating middle-leaders (refer Chapter 4).

While several single belief factors did not align with SRL theory (e.g., belief that SRL knowledge is simple, low quality epistemic ideals, low epistemic value for assessing students' SRL knowledge), some beliefs did align with SRL theory (e.g., belief that SRL knowledge comes from both teacher and student, SRL knowledge is learned, high epistemic value for developing students' SRL knowledge), suggesting that the teachers' belief system about SRL was inconsistent. Vosniadou et al. (2020) asserted that "little has been done so far to identify possible conflicting beliefs, to examine the structure of their [i.e., teachers'] belief systems and to use the information from the research to inform program direction and educational practice" (p. 15).

The present study sheds light on regular classroom teachers' belief system about SRL. The inconsistent and arguably underdeveloped nature of regular classroom teachers' beliefs about SRL aligns with concerns reported in previous studies (for example, Dignath-van Ewijk & van der Werf, 2012) and shares similarities with results reported for middle-leaders prior to their involvement in the PLC-ER about SRL (refer to Chapter 4).

Key finding 2

When the school's middle-leaders' participated in the PLC-ER about SRL, it was expected that improvements noted in middle-leaders' epistemic cognition and subsequent teaching practice would subsequently improve teachers' beliefs about SRL. In fact, regular classroom teachers' beliefs about SRL showed variable immediate changes. Most belief factors showed little change in no particular direction. Some improvement was noted in teachers' metacognitive regulation of epistemic cognition for teaching about SRL, teaching practice about SRL and perceptions of enablers and barriers to the explicit teaching of SRL strategies. However, the lack of improvement raises questions about the level of knowledge translation that occurred between middle-leaders and regular classroom teachers and the reasons for this lack of knowledge translation. Implications of findings are further considered in Chapter 9.

8. RQ5: CHANGES IN STUDENT SELF-REPORTED SRL BEHAVIOURS

This chapter reports results related to my fifth and final set of research questions, namely:

- (RQ5a.) Do middle leaders' and teachers' students' self-reported SRL behaviours change in response to a middle leaders' PLC-ER about SRL?
- (RQ5b.) If yes, what is the nature of the changes in middle leaders' and teachers' students' self reported SRL behaviours in response to a middle leaders' PLC-ER about SRL?
- (RQ5c.) Are the changes in middle leaders' and teachers' students' SRL behaviours in response to a middle leaders' PLC ER about SRL sustained over time?

To answer this set of research questions and evaluate related hypotheses, I collected and analysed middle-leaders' students' responses to the SRL Process Protocol (refer 3.7.7) and, middle-leaders' and teachers' students' responses to the Metacognitive Awareness Inventory (refer 3.7.8). Results are reported and discussed in the following sections.

As the following sections show, my hypotheses related to changes in middle-leaders' and teachers' students' self-reported SRL behaviours were *supported*, in that:

- (H5a.) Middle leaders' and teachers' students' self-reported SRL behaviours changed in response to a middle leaders' PLC ER about SRL.
- (H5b.) Middle leaders' and teachers' students' self reported SRL behaviours enhanced after the middle leaders' PLC ER about SRL.
- (H5c.) Changes in middle leaders' and teachers' students' self reported SRL behaviours were sustained 9-months after the conclusion of the middle leaders' PLC ER about SRL.

8.1. Student SRL Process Protocols

As described in the Method chapter, middle-leaders' students' self-reported SRL behaviours on the SRL Process Protocol were evaluated using the SRL Process Protocol Rubric (refer Table 3.21). A total of 49 marks was available and divided as follows: Forethought – 17 points, Performance – 15 points, and Self-reflection – 17 points. Scores for each phase of student SRL Process Protocols (Forethought, Performance and Self-reflection) at Week 0 (pre-intervention), Week 6 and Week 12 (immediate post-intervention) are reported in Figure 8.1. The higher the score the higher the level of SRL.

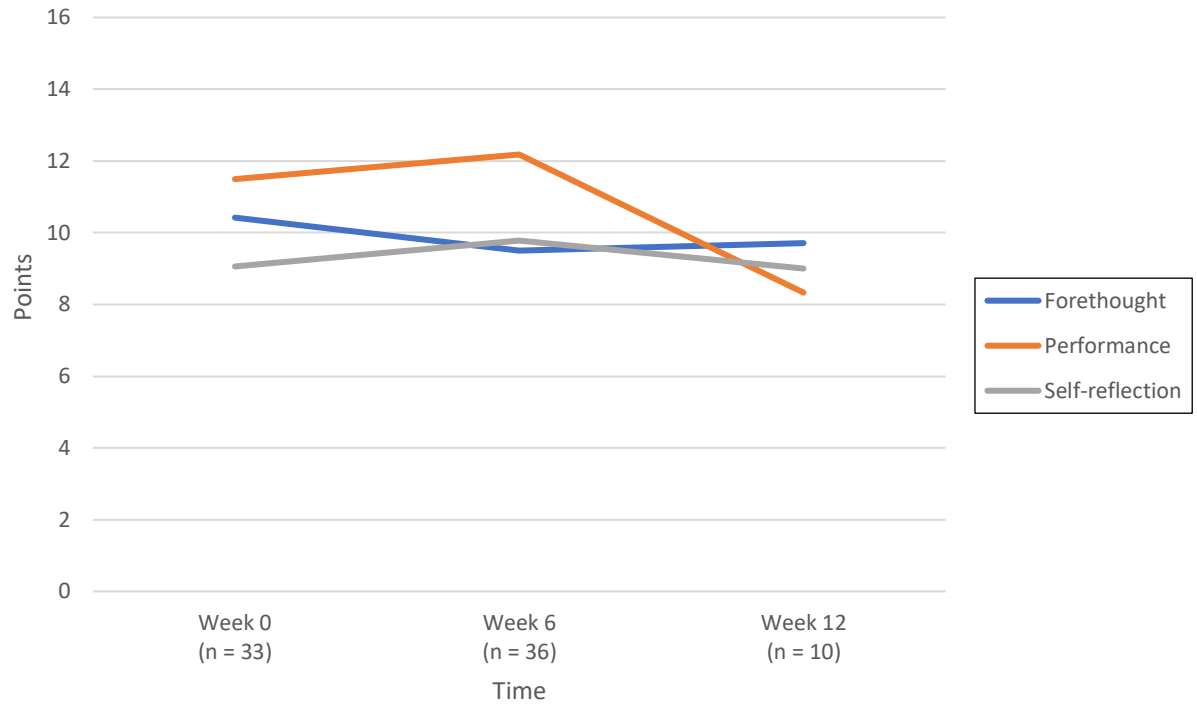

Figure 8.1. Combined scores for student SRL Process Protocols

From Figure 8.1, prior to the middle-leaders' PLC-ER about SRL at Week 0, students' SRL behaviours, as reported on the SRL Process Protocol, were of medium quality. Mid-way through the middle-leaders' PLC-ER about SRL at Week 6, improvements were noted across the *Performance* (+0.69) and *Self-reflection* (+0.72) phases, with a decline in the *Forethought* (-0.92) phase. It is not clear why this decline in the forethought phase occurred. Interestingly, immediately after the middle-leaders' PLC-ER about SRL at Week 12, there was a decline in students' SRL behaviours across all dimensions when compared with Week 0.

Given the increases in the time middle-leaders spent explicitly teaching SRL strategies (reported in section 3.9) and a consensus in the literature supporting the effect of explicit teaching of SRL strategies on students' SRL behaviour (refer section 1.5), improvements were expected across all three phases, so a decline was surprising. There are several explanations of this finding. Firstly, as students engaged with the written SRL Process Protocols, their motivation and engagement with the protocol may have decreased over time, compromising the quality of their responses on the SRL Process Protocols at Week 12. Secondly, as the quality of school middle-leaders' epistemic cognition for teaching about SRL improved and they spent more time explicitly teaching about SRL strategies in their lessons, they may have felt that less explicit instruction or student prompting needed to accompany the SRL Process Protocols, again compromising the quality of students' responses on their SRL Process Protocols. Thirdly, there was a noticeable decline in the number of students who submitted SRL Process Protocols that matched with the SRL Process Protocols submitted prior to the

middle-leaders' engagement in the PLC-ER about SRL, potentially affecting the validity of the responses. Therefore, the decline noted at Week 12 should be heeded with particular caution. Lastly, it is also possible that students' self-reported SRL behaviours varied with the lesson context. Therefore, lessons where the SRL Process Protocol was used in Week 12 may not have been particularly well matched to the contexts of the first data collections lessons.

8.2. Metacognitive Awareness Inventory

As described in the Method chapter (refer Section 3.7.8), students' self-reported SRL behaviours were also measured using their responses to a Metacognitive Awareness Inventory (MAI). In this section, I report the confirmatory factor analyses of the eight theoretical sub scales of the Metacognitive Awareness Inventory. Following this, I present descriptive comparisons of means at the three time-points that the Metacognitive Awareness Inventory was completed (e.g., Week 0, Week 12 and Week 52).

8.2.1. Confirmatory factor analyses of the MAI

As described in the Method chapter (refer Section 3.8.5), confirmatory factor analysis was applied to all eight theoretical sub factors as part of the MAI. Findings are reported in the following sections.

Knowledge about cognition

Congeneric model for declarative knowledge

The eight questionnaire items belonging to the Declarative Knowledge (Dec_know) scale were entered into a single-factor model for analysis of its fit:

Dec_know_1: I understand my intellectual strengths and weaknesses.
Dec_know_2: I know what kind of information is most important to learn.
Dec_know_3: I am good at organizing information.
Dec_know_4: I know what the teacher expects me to learn.
Dec_know_5: I am good at remembering information.
Dec_know_6: I have control over how well I learn.
Dec_know_7: I am a good judge of how well I understand something.
Dec_know_8: I learn more when I am interested in the topic.

The initial Declarative Knowledge single factor model showed a poor fit with the data when all eight items were included [Chi square (20) = 22.534, $p < .312$; SRMR = .0478; PCMIN/DF = 1.127; RMSEA = .028; IFI = .982; TLI = .973; CFI = .981]. I used estimates and modification indices, when permitted, to trim the model. When I removed two items (Dec_know_4, Dec_know_8), the model fit indices improved greatly. In examining closely, the wording of items 4 and 8 it appears that they address teachers' expectations and epistemic interest and do not seamlessly fit with the factor of Declarative knowledge. Therefore, I considered it

theoretically appropriate to remove these items from the Declarative Knowledge scale. The remaining 6 items in the final model, displayed in Figure 8.2, loaded significantly onto the Declarative Knowledge scale.

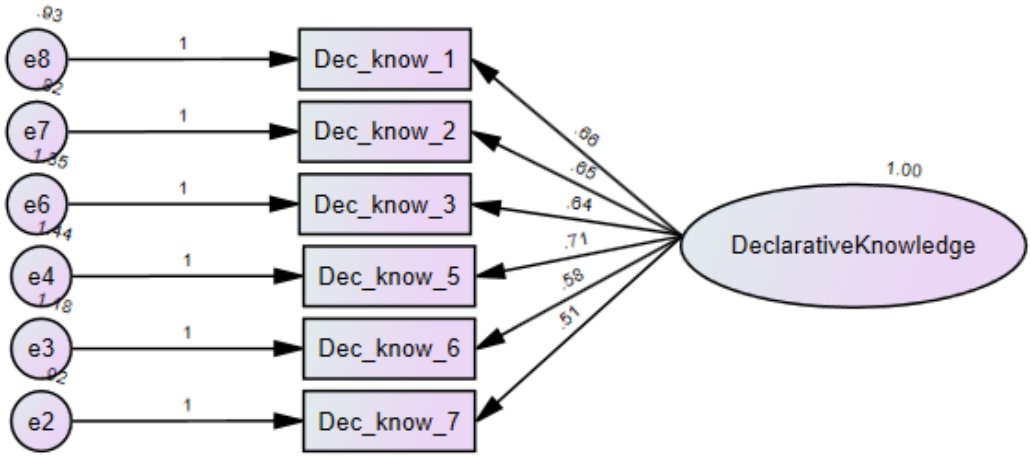

Figure 8.2. Measurement model of students' declarative knowledge scale

The Chi square value for the final measurement model for the Dec_know scale was not significant, Chi square (9) = 12.700, p = .177. Additional fit indices were as follows: SRMR = .0431; PCMIN/DF = 1.411; RMSEA = 0.050; IFI = .969; TLI = .945; CFI = .967. Overall, the CFA for the final Dec_know model showed a good fit, but questionable reliability (α = .679).

Congeneric model for procedural knowledge

The four questionnaire items belonging to the Procedural Knowledge (Proc_know) scale were entered into a single-factor model for analysis of its fit:

Proc_know_1: I try to use strategies that have worked in the past.
Proc_know_2: I have a specific purpose for each strategy I use.
Proc_know_3: I am aware of what strategies I use when I study.
Proc_know_4: I find myself using helpful learning strategies automatically.

The initial Procedural Knowledge single factor model showed a good fit with the data when all four items were included [Chi square (2) = 1.975, p < .373; SRMR = .0232; PCMIN/DF = .988; RMSEA = 0.000; IFI = 1.000; TLI = 1.001; CFI = 1.000]. Therefore, the four items in the model, displayed in Figure 8.3, loaded significantly onto the Procedural Knowledge scale.

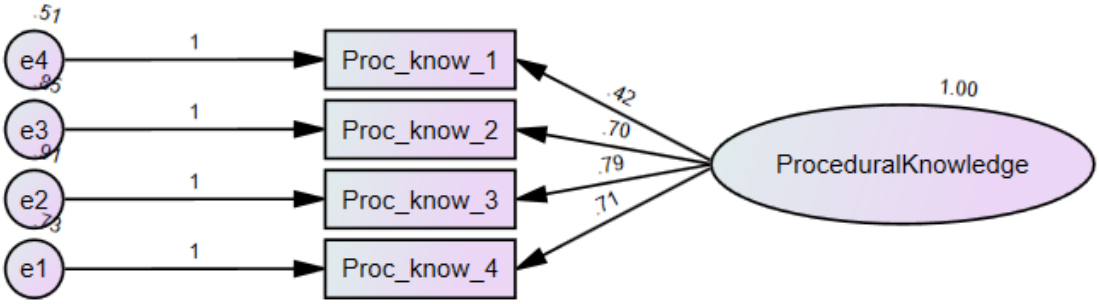

Figure 8.3. Measurement model of students' Procedural Knowledge scale

The Chi square value for the measurement model for the Proc_know scale was not significant. Overall, the CFA for the Proc_know model showed an acceptable fit, but questionable reliability (α = .687).

Congeneric model for conditional knowledge

The five questionnaire items belonging to the Conditional Knowledge (Con_know) scale were entered into a single-factor model for analysis of its fit:

Con_know_1: I learn best when I know something about the topic.
Con_know_2: I use different learning strategies depending on the situation.
Con_know_3: I can motivate myself to learn when I need to.
Con_know_4: I use my intellectual strengths to compensate for my weaknesses.
Con_know_5: I know when each strategy I use will be most effective.

The initial Conditional Knowledge single factor model showed a poor fit with the data when all five items were included [Chi square (6) = 11.950, p < .063; SRMR = .0535; PCMIN/DF = 1.992; RMSEA = .078; IFI = .929; TLI = .876; CFI = .926]. I used estimates and modification indices, when permitted, to trim the model. When I removed two items (Con_know_1, Con_know_3), the model fit indices improved greatly. In examining closely, the wording of items 1 and 3 it appears that they address different factors, namely prior knowledge and self-motivation. Therefore, I considered it theoretically possible to remove these items from the Conditional Knowledge scale. The remaining 3 items in the final model, displayed in Figure 8.4, loaded significantly onto the Conditional Knowledge scale.

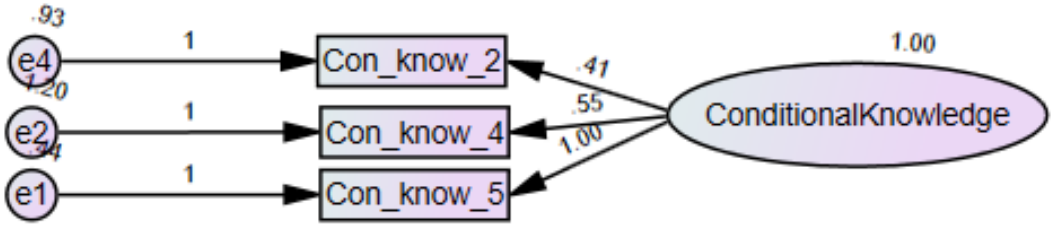

Figure 8.4. Measurement model of students' Conditional Knowledge scale

The Chi square value for the final measurement model for the Con_know scale was not significant, Chi square (1) = .826, p = .363. Additional fit indices were as follows: SRMR = .0213; PCMIN/DF = .826; RMSEA = 0.000; IFI = 1.004; TLI = 1.014; CFI = 1.000. Overall, the CFA for the final Dec_know model showed an acceptable fit, but poor reliability (α = .559).

Regulation of cognition

Congeneric model for planning

The seven questionnaire items belonging to the Planning (Plan) scale were entered into a single-factor model for analysis of its fit:

Plan_1: I pace myself while learning in order to have enough time.
Plan_2: I think about what I really need to learn before I begin a task.
Plan_3: I set specific goals before I begin a task.
Plan_4: I ask myself questions about the material before I begin.
Plan_5: I think of several ways to solve a problem and choose the best one.
Plan_6: I read instructions carefully before I begin a task.
Plan_7: I organize my time to best accomplish my goals.

The initial Planning single factor model showed a poor fit with the data when all seven items were included [Chi square (14) = 51.116, p < .000; SRMR = .0715; PCMIN/DF = 3.651; RMSEA = .128; IFI = .851; TLI = .770; CFI = .847]. I used estimates and modification indices, when permitted, to trim the model. When I removed two items (Plan_6, Plan_7), the model fit indices improved greatly. A review of items 6 and 7 indicated that they were appropriate theoretical items to include; however, perhaps the wording of these items need consideration to better map onto the Planning factor. The remaining five items in the final model, displayed in Figure 8.5, loaded significantly onto the Planning scale.

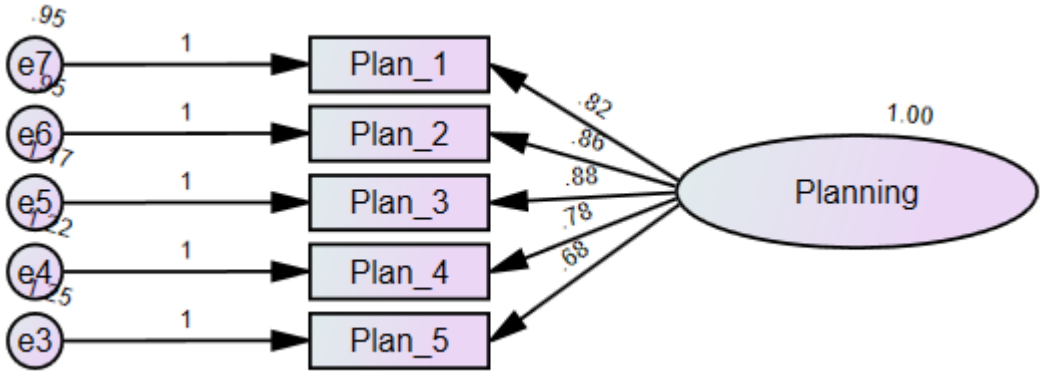

Figure 8.5. Measurement model of students' Planning scale

The Chi square value for the final measurement model for the Planning scale was not significant, Chi square (5) = 6.341, p = .274. Additional fit indices were as follows: SRMR = .0337; PCMIN/DF = 1.268; RMSEA = 0.041; IFI = .991; TLI = .982; CFI = .991. Overall, the final CFA for the final Planning model showed an good fit and acceptable reliability (α = .744).

The Congeneric model for Information Management Strategies

The ten questionnaire items belonging to the Information Management Strategies (Info_man) scale were entered into a single-factor model for analysis of its fit.

Info_man_1: I slow down when I encounter important information.
Info_man_2: I consciously focus my attention on important information.
Info_man_3: I focus on the meaning and significance of new information.
Info_man_4: I create my own examples to make information more meaningful.
Info_man_5: I draw pictures or diagrams to help me understand while learning.
Info_man_6: I try to translate new information into my own words.
Info_man_7: I use the organizational structure of the text to help me learn
Info_man_8: I ask myself if what I'm reading is related to what I already know.
Info_man_9: I try to break studying down into smaller steps.
Info_man_10: I focus on overall meaning rather than specifics.

The initial Information Management Strategies single factor model showed a good fit with the data when all ten items were included [Chi square (35) = 47.350, p < .079; SRMR = .0508; PCMIN/DF = 1.353; RMSEA = .047; IFI = .954; TLI = .938; CFI = .952]. Therefore, the ten items in the final model, displayed in Figure 8.6, loaded significantly onto the Information Management Strategies scale.

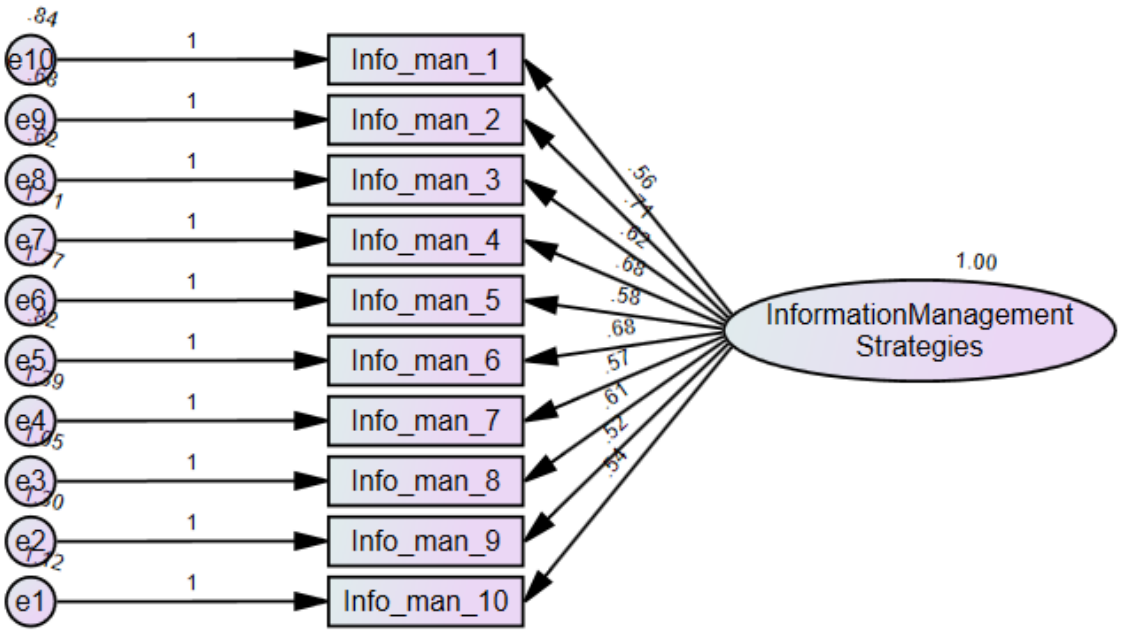

Figure 8.6. Measurement model of students' Information Management Strategies scale

The Chi square value for the final measurement model for the Info_man scale was not significant. Overall, the CFA for the Info_man model showed a good fit and an acceptable reliability (α = .767).

Congeneric model for comprehension monitoring

The seven questionnaire items belonging to the Comprehension Monitoring (Comp_mon) scale were entered into a single-factor model for analysis of its fit.

Comp_mon_1: I ask myself periodically if I am meeting my goals.

Comp_mon_2: I consider several alternatives to a problem before I answer.

Comp_mon_3: I ask myself if I have considered all options when solving a problem.

Comp_mon_4: I periodically review to help me understand important relationships.

Comp_mon_5: I find myself analyzing the usefulness of strategies while I study.

Comp_mon_6: I find myself pausing regularly to check my comprehension.

Comp_mon_7: I ask myself questions about how well I am doing while learning something new.

The initial Comprehension Monitoring single factor model showed a poor fit with the data when all seven items were included [Chi square (14) = 33.248, p < .003; SRMR = .0615; PCMIN/DF = 2.375; RMSEA = .092; IFI = .913; TLI = .866; CFI = .911]. I used estimates and modification indices, when permitted, to trim the model. When I removed two items (Comp_mon_2, Comp_mon_6), the model fit indices improved greatly. In examining closely, the wording of items 2 and 6 they seem theoretically appropriate; however, estimates and modification indices suggest the need for further consideration. The remaining five items in the final model, displayed in Figure 8.7, loaded significantly onto the Comprehension Monitoring scale.

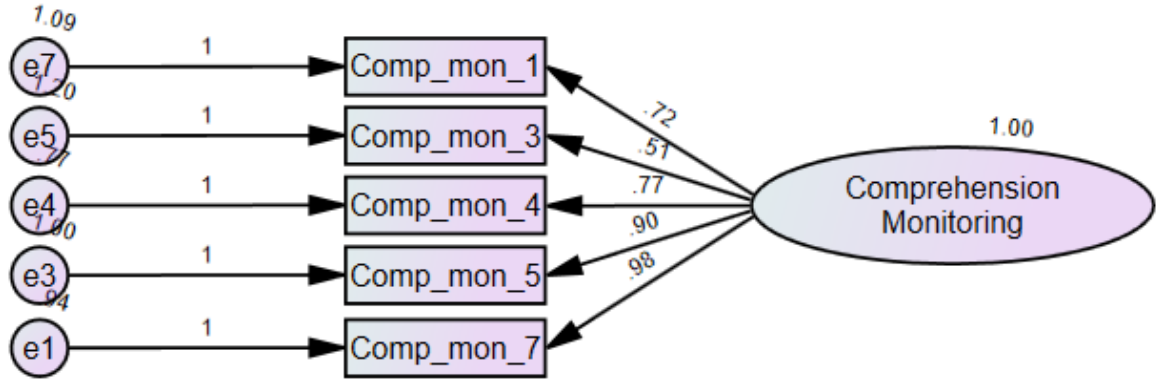

Figure 8.7. Measurement model of students' Comprehension Monitoring scale

The Chi square value for the final measurement model for the Comp_mon scale was not significant, Chi square (5) = 1.863, p = .868. Additional fit indices were as follows: SRMR = .0178; PCMIN/DF = 0.373; RMSEA = 0.000; IFI = 1.020; TLI = 1.041; CFI = 1.000. Overall, the CFA for the final Comp_mon model showed a good fit and acceptable reliability (α = .742).

Congeneric model for debugging strategies

The five questionnaire items belonging to the Debugging Strategies (Deb_stra) scale were entered into a single-factor model for analysis of its fit:

Deb_stra_1: I ask others for help when I don't understand something.
Deb_stra_2: I change strategies when I fail to understand.
Deb_stra_3: I re-evaluate my assumptions when I get confused.
Deb_stra_4: I stop and go back over new information that is not clear.
Deb_stra_5: I stop and reread when I get confused.

The initial Debugging Strategies single factor model showed a good fit with the data when all five items were included [Chi square (5) = 8.680, p < .123; SRMR = .0404; PCMIN/DF = 1.736; RMSEA = .067; IFI = .971; TLI = .941; CFI = .970]. Therefore, the five items in the model, displayed in Figure 8.8, loaded significantly onto the Debugging Strategies scale.

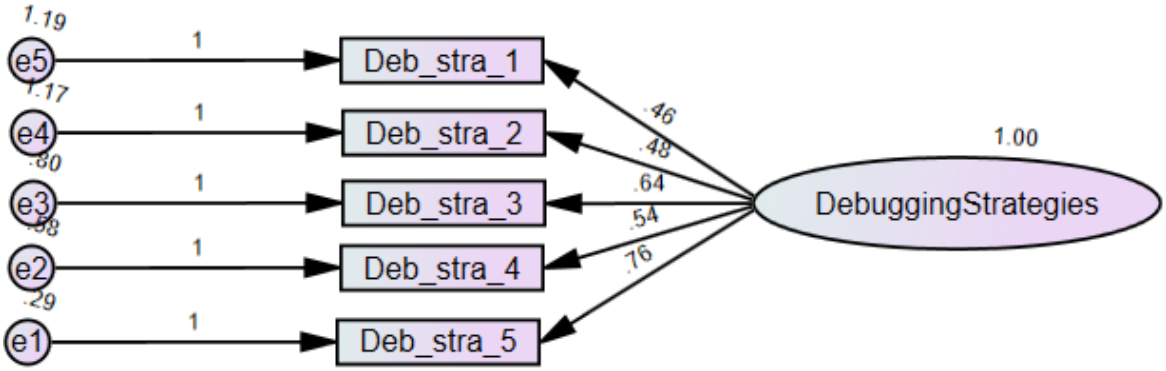

Figure 8.8. Measurement model of students' Debugging Strategies scale

The Chi square value for the final measurement model for the Deb_stra cale was not significant. Overall, the CFA for the Deb_stra model showed an good fit and questionable reliability (α = .676).

Congeneric model for evaluation

The six questionnaire items belonging to the Evaluation (Eva) scale were entered into a single-factor model for analysis of its fit:

Eva_1: I know how well I did once I finish a test.
Eva_2: I ask myself if there was an easier way to do things after I finish a task.
Eva_3: I summarise what I've learned after I finish.
Eva_4: I ask myself how well I accomplish my goals once I'm finished.
Eva_5: I ask myself if I have considered all options after I solve a problem.
Eva_6: I ask myself if I learned as much as I could have once I finish a task.

The initial Evaluation single factor model showed a good fit with the data when all six items were included [Chi square (9) = 9.263, p < .413; SRMR = .0369; PCMIN/DF = 1.029; RMSEA = .013; IFI = .998; TLI = .997; CFI = .998]. All six items in the model, displayed in Figure 8.9, loaded significantly onto the Evaluation scale.

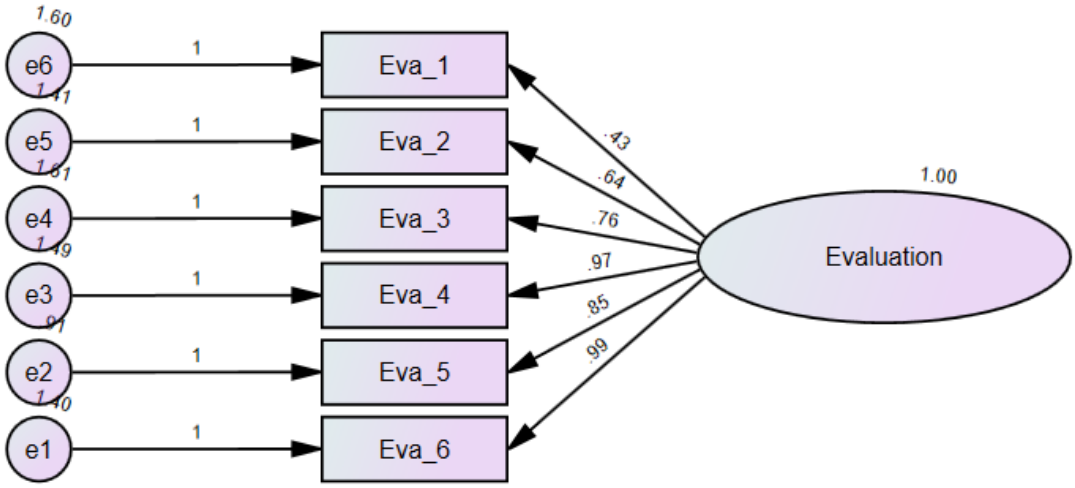

Figure 8.9. Measurement model of students' Evaluation scale

The Chi square value for the measurement model for the Evaluation scale was not significant. Overall, the CFA for the Evaluation model showed an good fit and acceptable reliability (α = .709).

8.2.2. Mean and standard deviations for confirmed factors

Mean and standard deviations for Likert scale items from the inventory, representing the eight confirmed MAI factors are reported in Table 8.1. These means include: pre-intervention, immediate post-intervention and long-term post-intervention, difference between pre-

intervention and immediate post-intervention and difference between pre-intervention and long-term post-intervention.

Table 8.1. Means for student responses to Metacognitive Awareness Inventory scales

Scale	Mean (SD)			Change scores	
	Week 0 (n = 163)	Week 12 (n = 142)	Week 52 (n = 106)	Week 12 minus Week 0	Week 52 minus Week 0
Knowledge of Cognition					
Declarative Knowledge	5.44 (0.76)	5.52 (0.80)	5.47 (0.70)	0.08	0.03
Procedural Knowledge	5.33 (0.79)	5.47 (0.80)	5.42 (0.80)	0.14	0.09
Conditional Knowledge	5.14 (0.84)	5.36 (0.90)	5.31 (0.91)	0.22	0.17
Regulation of Cognition					
Planning*	4.70 (0.93)	4.80 (1.02)	4.80 (0.89)	0.10	0.10
Information Management Strategies*	5.16 (0.70)	5.34 (0.72)	5.26 (0.68)	0.18	0.10
Comprehension Monitoring*	4.69 (0.90)	4.92 (0.98)	4.85 (0.87)	0.23	0.16
Debugging Strategies	5.77 (0.71)	5.75 (0.81)	5.72 (0.70)	-0.02	-0.05
Evaluation*	4.61 (0.91)	4.84 (0.96)	4.79 (1.00)	0.23	0.18

* Factors that achieved above 0.7 Cronbach's alpha indicating acceptable reliability.

From Table 8.1, prior to the middle-leaders' PLC-ER about SRL at Week 0, students reported a medium to high level of SRL behaviours on the Metacognitive Awareness Inventory (scores ranging from 4-6). When compared with Week 0 results, the results immediately after the middle-leaders' PLC-ER about SRL at Week 12 and again 9-months after the PLC-ER about SRL at Week 52, with the exception of *Debugging Strategies*, students reported slightly improved SRL behaviours. The noted trend of increasing students' SRL behaviours is an interesting result when contrasted with results from the student SRL Process Protocols. At Week 12, the students' Metacognitive Awareness Inventories indicated a slight improvement, while students' SRL Process Protocols (Figure 8.1) indicated a slight decline. One explanation

for this finding is the difference in student measure. The Metacognitive Awareness Inventory was conducted as a Likert-scale questionnaire, a closed activity and measures SRL as a competence (Michalsky, 2017; Winne & Perry, 2000), whereas the SRL Process Protocol is an open and generative activity and evaluates SRL as a situated event (Michalsky, 2017; Winne & Perry, 2000). Likert-scale questionnaires have pre-determined choice options that a student needs to decide between and require less effort to complete than a worksheet that requires students to generate responses. Alternatively, at Week 12, 106 students completed the Metacognitive Awareness Inventory, while only 10 students completed their SRL Process Protocols. Therefore, the cohorts of students varied substantially resulting in the equally high variation between the two SRL measures. Given the difference between students' self-reported SRL behaviours reported in the Metacognitive Awareness Inventory and students' SRL Process Protocols, further consideration of tools to measure students' SRL is required.

A series of Friedman's tests were calculated to determine the statistical significance of changes in students' SRL as reported on the MAI over time. Results are documented in Table 8.2.

Table 8.2. Friedman's test results

		Friedman's test		
Factor	**N**	**Chi Square**	**df**	**P value**
Declarative Knowledge	23	.881	2	.644
Procedural Knowledge	23	7.224	2	.027*
Conditional Knowledge	23	.961	2	.618
Planning	23	3.124	2	.210
Information Management Strategies	23	4.742	2	.093
Comprehension Monitoring	23	.878	2	.645
Debugging Strategies	23	2.424	2	.298
Evaluation	23	5.551	2	.062

*Significant

Table 8.2 indicates that only one change (Procedural Knowledge) in students' SRL, as recorded on the MAI, was significant. The factor *Procedural Knowledge* indicated a significant improvement over three time points, with the remaining factors indicating non-significant results.

Given the importance of SRL, discussed in Section 1.5, findings reported in this section suggests that a PLC-ER about SRL with school middle-leaders has potential to stimulate improvements in students' self-reported SRL behaviours (i.e., refer recorded changes in mean scores), but further studies are required to determine whether a PLC-ER about SRL with middle-leaders can have significant impact on students' SRL.

8.3. Summary of Findings about Student SRL Behaviours

As a result of my analysis the following propositions are identified regarding a more deliberate and consistent approach to introducing SRL as a whole school endeavour.

Key finding 1

Results reported in this chapter reveal that prior to school middle-leaders' engagement in a PLC-ER about SRL, students' SRL was less than optimal. This is consistent with previous studies that have highlighted gaps in students' knowledge about SRL, or argued for the development of students' knowledge about SRL as it underpins their SRL behaviours (Askell-Williams et al., 2012; Bjork et al., 2013; Lawson & Askell-Williams, 2012).

Key finding 2

With middle-leaders' participation in the PLC-ER about SRL, students' SRL behaviours showed variable changes according to which student SRL measure was used. Indeed, it is unclear whether middle-leaders' participation in a PLC-ER about SRL had a dispersion of effects to students' SRL behaviours (Kauffman, 1995; Rickles et al., 2007; Schneider & Somers, 2006).

Still, even the slight improvements, albeit most insignificant, reported in students' SRL behaviours is a particularly promising finding as the benefits of students engaging in SRL is undeniable (Dignath & Büttner, 2008; Dignath et al., 2008; Hattie & Yates, 2014) and, as Bjork et al. (2013) stated, "knowing how to manage one's own learning activities [i.e., SRL] has become, in short, an important survival tool" (p. 418) in today's constantly evolving social and work landscape.

9. CONCLUSIONS, RECOMMENDATIONS AND IMPLICATIONS

In this chapter, I highlight key conclusions that surfaced through data analysis. Following this I detail recommendations and implications by three system levels, namely Government and education authorities, Higher Education and Schools.

9.1. Conclusions

This thesis aims to better understand sustainability of school improvement initiatives about SRL by investigating emergent changes in a school when middle-leaders participated in a PLC-ER about SRL. The following conclusions were drawn:

- At the beginning of the data collection period of this study, participating middle leaders' epistemic cognition and subsequent teaching practices about SRL were arguably impoverished; participating regular classroom teachers' beliefs about SRL were inconsistent; and participating students' SRL were less than optimal.
- A PLC ER about SRL can improve middle leaders' epistemic cognition for teaching and subsequent teaching practice about SRL.
- Epistemic reflexivity about SRL appears to influence middle leaders' knowledge and beliefs, and their teaching practice about SRL.
- A "structural-prompt" might be required to support middle-leaders' continued engagement in high quality epistemic cognition about SRL and, therefore, the sustainability of school improvement initiatives about SRL.
- Knowledge translation between middle leaders and regular classroom teachers may require explicit instruction from senior leadership or consideration of middle leaders' role identity.

The following sub-sections document these conclusions.

9.1.1. Impoverished epistemic cognition, inconsistent beliefs

One prominent pattern documented in Chapters 4 through 8 was the low-quality state of middle-leaders' knowledge and beliefs, their epistemic reflexivity and their teaching practice regarding SRL. To reiterate, prior to engagement in a PLC-ER about SRL, middle-leaders' knowledge and beliefs about SRL were underdeveloped and inconsistent with SRL theory, a finding consistent with studies that have focussed on the quality of teachers' knowledge (Barr & Askell-Williams, 2020a; Dignath & Büttner, 2018; Spruce & Bol, 2015). In addition, analysis of think-aloud data indicated that middle-leaders rarely engaged in epistemic reflexivity about SRL; and when they did, quality of engagement was low. This was particularly disappointing given the role epistemic reflexivity plays in teaching behaviours (Feucht et al., 2017; Fives et

al., 2017; Lunn Brownlee et al., 2017). Furthermore, middle-leaders spent little time explicitly teaching SRL strategies, a finding that is consistent with previous studies that have investigated teachers' teaching practice about SRL (Dignath & Büttner, 2018; Hattie & Yates, 2014). The quality of middle-leaders' epistemic cognition and teaching practice about SRL documented in my study offers an explanation regarding the minimal uptake of SRL teaching initiatives currently reported in studies (Dignath & Büttner, 2018; Vosniadou et al., 2020). If middle-leaders are not engaged in high-quality epistemic cognition about SRL, it will be difficult for them to support and monitor their students' SRL progress, and to support their teaching teams to do the same (refer Section 2.1 for literature reviewed about middle-leaders' role in supporting teacher professional competence).

Results also demonstrated that regular classroom teachers' beliefs about SRL were inconsistent. An inconsistent belief system about SRL is reason for concern as theoretically, this can reduce the likelihood of teachers engaging in the explicit teaching of SRL strategies. Regular classroom teachers' inconsistent beliefs about SRL aligns with concerns reported in previous studies (Dignath-van Ewijk & van der Werf, 2012; Lombaerts et al., 2009; Vosniadou et al., 2020) and shares similarities with results reported for middle-leaders.

Lastly, results revealed that students' SRL was less than optimal. This was no surprise as previous studies have raised concerns about students' SRL (Askell-Williams et al., 2012; Bjork et al., 2013; Lawson & Askell-Williams, 2012). However, it seems there is still a substantial gap between the goals of local and global agendas (ACARA, 2020; ACT Education Directorate, 2018; Education Council, 2019) that advocate for students' SRL, and the reality of how students are currently engaged in SRL.

9.1.2. Improved middle-leader epistemic cognition and teaching practice

Overall, results reported and discussed in Chapters 4 through 8, suggest that a PLC-ER about SRL offers a vehicle for improved sustainability of school improvement initiatives about SRL. Results detailed in Chapter 4 and 5 demonstrate that a PLC-ER about SRL can stimulate development of middle-leaders' knowledge and beliefs about SRL, and their epistemic reflexivity about SRL, two key components of epistemic cognition about SRL. Indeed, epistemic cognition is important for the critical thinking required to respond to ill-structured problems, such as sustainable school improvement (Hofer, 2018; King & Kitchener, 1994, 2002).

Additionally, as demonstrated in Chapter 6, following participation in a PLC-ER about SRL, middle-leaders' teaching practice about SRL improved. This is a particularly positive finding given that Callan, Yang, Zhang, and Sciuchetti (2020) stated "the promise of evidence-based SRL practice cannot be realised unless successfully adopted into typical education settings" (p. 4). At Chapter 8, the initial trend of improvements in middle-leaders' and regular classroom teachers' students' SRL behaviours may also provide evidence for a middle-leaders' PLC-ER

about SRL as a functional method to achieving the ambitious goals documented on local and global agendas (ACARA, 2020; ACT Education Directorate, 2018; Education Council, 2019; OECD, 2018). However, findings regarding changes in students' SRL were not significant and further studies are required to establish any meaningful change.

In summary, these results directly respond to calls to action for effective professional education that (1) supports leaders to consider the varying levels of the system (e.g., agent, school government) (Fullan, 2006), (2) promotes teachers' competence about SRL (Karlen et al., 2020) and (3) leads to the inclusion of evidence-based SRL practices in the classroom (Vosniadou et al., 2020). The observed positive effects of a PLC-ER about SRL might be attributed to different reasons, two of which I explore in the subsequent paragraphs.

Firstly, the PLC-ER about SRL was grounded in conceptual change approaches. Researchers have called for professional education that addresses different aspects of educators' epistemic cognition for teaching about SRL, for instance, their knowledge and beliefs about SRL (Dignath-van Ewijk & Veenman, 2020; Vosniadou et al., 2020). The present study supports the notion that conceptual change approaches can benefit the design of professional education about SRL. Numerous conceptual change approaches exist (Chinn et al., 2013; Duit et al., 2013; Inagaki & Hatano, 2013; Ohlsson et al., 2012; Walter, 2015); however, results reported in Chapters 4 through 6 also provide evidence for the inclusion of educative tools that directly engage educators in their epistemic reflexivity about SRL.

Secondly, the PLC-ER about SRL existed as a kind of sub-system of the school (i.e., Complex Adaptive System). It was not a fixed external stimulus but another agent of the Complex Adaptive System that not only generated outputs but was also influenced by inputs of the system. This is similar to what Grigorenko (2009) considered as *dynamic assessment*, whereby instruction is merged with assessment in a mutual partnership. Schools are constantly changing (Johnson et al., 2004; Koh & Askell-Williams, 2020) and as changes occur in parts of the school, there is a level of required reciprocal change in the school improvement initiative. This reciprocal change is similar to what Rickles et al. (2007) explained as "coevolution, a term originating in evolutionary biology to describe the way organisms create their environment and are in turn moulded by that environment" (p. 935). The school and the improvement initiative were co-evolving as one Complex Adaptive System. Therefore, professional education interventions could be viewed as malleable vehicles responsive to the needs of the school, but still honouring the rigor of the research base, or what Shelton et al. (2018) explained as "the continued use of program components at sufficient intensity" (p. 55). Accepting coevolution of both school and improvement initiative further reinforces why high-fidelity program implementation is an unrealistic goal in schools (Lendrum & Humphrey, 2012). Drawing on the Structure of the Observed Learning Outcome (SOLO) taxonomy (Biggs & Collis, 1982), high-fidelity implementation might be considered "unistructural", whereas the notion of

coevolution is similar to the SOLO “extended abstract” category, as it requires a level of creation and generation within the school. A school improvement initiative that is unable or lacks capacity to engage in continuous improvement, or co-evolution, with other parts of the school’s complex adaptive system is unlikely to sustain. Essentially, one must ask, is a school improvement initiative (i.e., PLC-ER about SRL) adaptable enough to evolve with the system’s self-organisation? Therefore, it raises questions as to the usefulness of studying “snapshot” determinants of SRL teaching initiatives (De Smul et al., 2018; Heirweg et al., 2020; Thomas et al., 2020), or even setting goals for high-fidelity implementation in schools (Han & Weiss, 2005), but rather focussing on how SRL teaching initiatives transform with other adaptations that occur in/for the school.

9.1.3. Epistemic reflexivity mediates knowledge, beliefs and teaching practice

One important finding that emerged through this research is that even when middle-leaders reported high-quality knowledge and beliefs about SRL, it did not consistently translate into observed classroom practice. Researchers have typically explained the lack of explicit teaching about SRL observed in classrooms to the quality of teachers’ knowledge and beliefs about SRL (Dignath-van Ewijk & van der Werf, 2012; Lawson et al., 2018). In Chapter 2, I too argued that without sufficient knowledge about SRL, teachers will be unable to set epistemic aims about SRL or select reliable processes to achieve their epistemic aims. My results revealed that while high quality knowledge and beliefs about SRL are required to be able to explicitly teach SRL strategies, high-quality knowledge and beliefs alone are insufficient as the process of epistemic reflexivity appears to mediate the translation of knowledge to practice.

For example, an educator might epistemically value the explicit teaching of SRL strategies enough to be listed in the *discernment* moment of their epistemic reflexivity. However, the explicit teaching of SRL strategies might not be selected among competing priorities in subsequent moments of their epistemic reflexivity, namely *deliberation, decision* or *deed* (from the DDD-D framework in Section 2.5.2). If the explicit teaching of SRL strategies is not prioritised in each moment of epistemic reflexivity, then educators are unlikely to commit to any *decisions* that lead to changes in practice (i.e., *deed*). This coincides with what Karlen et al. (2020) argued as the importance of understanding teachers’ attitudes (and intention to implement SRL) and the barriers to their success. Teachers and school middle-leaders may have the intention to teach SRL and may even *decide* to list SRL as a priority in their process of epistemic reflexivity, but something might limit progressing this *decision* to the *deed* moment (i.e., teaching behaviour) of the process.

My study also found that the explicit teaching of SRL strategies was heavily dependent on lesson context. Analysis of data from middle-leaders’ think aloud protocols identified that quality of epistemic aims varied with lesson context (e.g., lesson content, aims, activities). For instance, after professional education session 2, one middle-leader (ML2) reported high quality

epistemic aims as he was explicitly teaching a new strategy in the lesson. However, after professional education session 3, he reported lower quality epistemic aims as the lesson was focused on consolidation of the previous learnt strategy. Therefore, quality of reported epistemic aims were highly dependent on lesson context and decisions of the individual middle-leader (i.e., epistemic reflexivity). This is not surprising given the contextual nature of epistemic cognition discussed at Section 1.4 and that educators are agents within a school's Complex Adaptive System (Koh & Askell-Williams, 2020; Rosas, 2017).

9.1.4. Prompting required to support engagement and sustainability

As previously stated, a small sample at nine months after the PLC-ER about SRL limits the conclusions that can be drawn regarding long-term impact of my study. However, consideration of matched middle-leaders' responses to the TEC-SRL questionnaire, their reported epistemic reflexivity and observed teaching practice indicated a pattern of slight decline between immediately after the PLC-ER about SRL (Week 12) and nine months after the PLC-ER about SRL (Week 52). This decline was confirmed by the think-aloud transcripts. For example, in their final think-aloud, ML3 stated "Readers' Workshop really needs them to be independent", supporting the need for teaching of SRL, but also stated "we haven't used any [SRL] strategies in Readers' Workshop [this year: Week 52]", indicating a decline in their self-reported teaching practice compared with the year prior (Week 12). There are many explanations for why this decline occurred.

One explanation is that the school may have been experiencing what Fullan (2006) referred to as a "periodic plateau" (p. 120). Fullan explained that there are peaks and troughs related to change within the cyclical process that is sustainability. This is what Loehr and Schwartz (2003) explained in terms of energy – "because energy capacity diminishes both with overuse and with underuse, we must balance energy expenditure with intermittent energy renewal" (p. 11). It is possible that school middle-leaders may have been low on energy for change or reenergising for the next instalment of SRL thinking and teaching.

Another explanation is that a change of school principal at the beginning of 2019 may have influenced the decline noted nine months after the middle-leaders' PLC-ER about SRL at Week 52. Shaked and Schechter (2016) stated that "[school] principals must allow teachers to work continuously as a team, reaching understandings and agreements through reflective dialogue concerning the optimal teaching practices to be used" (p. 180). A change of principal in the year following the middle-leaders' PLC-ER about SRL may have limited or halted the dialogue among middle-leaders and regular classroom teachers, resulting in less-than-optimal long-term results. This change can also be explained from the perspective of Complex Adaptive Systems, in that the school may have self-organised (Rickles et al., 2007), with the new principal dedicating resources to initiatives unrelated to SRL.

Furthermore, middle-leaders may have experienced forgetting (Ebbinghaus, 1885), or felt their students had increased knowledge about certain SRL strategies and it was unnecessary for continued teaching of SRL strategies. Also, it is noticeable that there was substantial participant attrition in this study across two academic years. In addition to staff movements, participants' motivation to fully engage with the data collection tasks may have simply waned with the distance from the initial introduction of the research project.

Alternatively, when middle-leaders were engaged in a PLC-ER about SRL, they were actively engaged in epistemic cognition about SRL, leading to a perception of the school's high value for SRL. When the PLC-ER about SRL was removed, perception of the school's value of SRL may have diminished resulting in the decline noted. This pattern of diminishing impacts speaks directly to the sustainability of school improvement initiatives, as I discussed in the introduction (refer Section 1.2). In other words, the PLC-ER about SRL acted as an epistemic cognitive and teaching prompt that led to observed improvements; however, when that prompt was removed, the teaching of SRL appeared to fall from middle-leaders' foci. That is, their engagement in epistemic cognition about SRL declined. As further evidence, ML2 commented that without the external prompt of the PLC-ER and the presence of the researcher (an expert on the subject matter), "other priorities had taken precedence" (following lesson observation, Week 52). This directly relates to the *deliberation* and *decision* moments of epistemic reflexivity, in which educators are engaged in a process of prioritisation.

Due to the nature of schools as Complex Adaptive Systems (refer 1.1) engaged in a process of sustainability (refer 1.2), new teaching approaches may not always be prioritised or sustained (Johnson et al., 2004; Koh & Askell-Williams, 2020). However, given SRL as a construct and that it underpins life-long learning, it is likely to continue in some form as a priority on changing agendas, as was the case with the previous Melbourne Declaration on Education Goals for Young Australians (MCEETYA, 2008) and the recently published Alice Springs (Mparntwe) Education Declaration (Education Council, 2019). Noting this, the question then is – what support structures are required in schools to act as continuous prompts for educators so that they continue to engage with the explicit teaching of SRL strategies? Further research is required, especially studies that focus on the long-term and frequent data collection to investigate and potentially mitigate the decline observed between Weeks 12 and 52 in this study.

Results from the present study suggest that prioritisation of SRL teaching initiatives in schools may require continuous professional development structures to keep it at the forefront of school middle-leaders' and teachers' minds. Continuous professional education is a large focus of the TALIS 2018 report (OECD, 2019) reinforcing that continuous professional education that promotes epistemic reflexivity about SRL would be highly beneficial if included in schools' documented strategic plans that include a focus on SRL (Askell-Williams & Koh,

2020). In addition, schools could integrate scaffolds/support structures (Askell-Williams et al., 2012) as part of the planning and implementation of the PLC-ER about SRL to support teachers' to sustainably engage in epistemic reflexivity about SRL.

Drawing on results reported at 4.7, school administrators need to carefully consider the range of initiatives asked of teachers and how this impacts teachers' ability to successfully implement them. Additionally, it is important that "time" is allocated to the explicit teaching of SRL strategies in schools. This may be achieved in the careful management of competing initiatives (or reduction of competing initiatives), or a re-prioritisation in curriculum expectations. Lastly, as staff buy-in was also listed as a barrier to implementation by participants in my study, schools (and researchers) must consider how they increase staff engagement with the school-improvement initiative. Increasing staff knowledge and epistemic reflexivity about SRL, through participation in a PLC-ER about SRL, given the positive perceptions recorded from school middle-leaders may offer an avenue to effectively increase staff buy in.

9.1.5. Knowledge translation requires explicit instruction

Of particular interest is the disparity in the changes in epistemic cognition that emerged between middle-leaders' epistemic beliefs and regular classroom teachers' epistemic beliefs. For instance, at 4.2, middle-leaders reported a belief that SRL knowledge was slightly complex at the beginning of the study, but then reported that SRL was more complex as they participated in the PLC-ER about SRL. In contrast, at 7.1, regular classroom teachers believed that SRL knowledge was relatively simple in comparison to other subjects (e.g., Maths), and little change occurred in this belief as middle-leaders participated in the PLC-ER about SRL. As another example, at 4.3, middle-leaders valued SRL knowledge. Their epistemic value for SRL knowledge increased as they participated in the PLC-ER about SRL and for nine months after its conclusion. In comparison, at 7.2, regular classroom teachers, who also valued SRL knowledge, reported a decline in their epistemic value about SRL after the conclusion of the middle-leaders' PLC-ER about SRL. Substantial discrepancies in changes between the two groups of participants were also noted in the setting of epistemic aims and perceptions of enablers and barriers to implementing SRL teaching initiatives. There are many possible explanations for this finding.

Moving beyond the potential limitation of sample size, it is feasible that the difference in middle-leaders and regular classroom teachers' epistemic beliefs about SRL is due to the lack of knowledge translation that occurred between middle-leaders and regular classroom teachers. Because regular classroom teachers were not directly exposed to the PLC-ER about SRL, they were reliant on the middle-leaders' sharing their developing SRL knowledge (i.e., sharing their learning, facilitating opportunities for their own teaching teams to develop knowledge about SRL)(Stoll & Kools, 2017). If effective knowledge translation had occurred, it is feasible that regular classroom teachers' beliefs about SRL would have been similarly

enhanced as did the middle-leaders' beliefs. Middle-leaders have been touted as the 'bridge and broker' between activities that occur with leadership and the broader school context (i.e., regular classroom teachers)(Grootenboer et al., 2019). However, their effectiveness in this pivotal role may depend on (1) middle-leaders' role identity, and (2) instruction from senior leadership.

The first explanation for this lack of knowledge translation is that middle-leaders' did not perceive knowledge translation about SRL within their role identity. That is, they did not view themselves as instructional leaders about SRL. Instructional leadership is a well-supported and widely acknowledged contemporary approach to educational leadership (Hallinger, 2010; Shaked, 2020). Sometimes referred to as leadership of learning, instructional leadership incorporates a leader's role in teacher-mentoring, modelling teaching practice and facilitating professional learning communities within their faculty teams, with an aim of improving educational outcomes of students. But how do middle-leaders' perceive their role identity about SRL? Do they perceive knowledge translation (and dissemination) about SRL to be part of their middle-leadership role? Studies have demonstrated that middle-leaders can influence sustainability of school improvement initiatives (for example, Lipscombe et al., 2020) and middle-leadership has an important role in the implementation of larger scale Australian school improvement initiatives (e.g., Victorian Middle-Years Literacy and Numeracy Support Initiative, New South Wales' Hub Schools). The external perception of middle-leaders' roles seem clear – as knowledge translators – but whether this applies to the present study about SRL is unclear. Further investigation of the middle-leaders' role identity regarding instructional leadership about SRL is required.

Another explanation of the lack of knowledge translation about SRL is that senior leadership, who have a prominent role in school improvement (Shaked & Schechter, 2016), did not make their expectations about middle-leaders' roles as knowledge translators explicit. While senior leadership's expectations of knowledge translation were implicit in the investment (funding, time) in the PLC-ER about SRL, their attendance at some of the middle-leaders' PLC-ER about SRL sessions and their promotion of SRL in the wider school, these expectations may not have been clearly acknowledged by the middle-leaders themselves. Lipscombe et al. (2020), in their case study of Australian middle-leaders concluded that "middle-leaders' influence was dependent on executive leadership support" (p. 1). It is conceivable that if middle-leaders were explicitly prompted (Brown, Campione, & Day, 1981; Dignath-van Ewijk et al., 2013) during the PLC-ER about SRL to think not only about actions in their own classrooms, but also with their own faculties, then perhaps greater knowledge translation might have occurred. An implication of this discussion is that greater instruction and scaffolding may be required to support the knowledge translation between middle-leader and regular classroom teacher.

9.2. Recommendations and Implications: Transferring Research into Practice

This section details implications for practice of my research by levels of systemic influence: Government and education authorities, Higher Education and Schools.

9.2.1. Australian Government and education authorities

The Australian Government and subsequent education authorities (e.g., Independent Schools Victoria) have set some useful goals in relation to SRL (ACT Education Directorate, 2018). However, concerns have been raised about how these goals are manifested in practice (Care & Kim, 2018; Voogt & Roblin, 2012).

The present study highlights the influential role of educators' epistemic cognition for teaching about SRL, particularly epistemic reflexivity, as a potential influencing variable between goal and sustainable practice. It is through epistemic reflexivity that middle-leaders process competing teaching goals and make decisions about practice. Therefore, the Australian Government might consider the current testing and examination regimes that influence teachers' epistemic reflexivity about SRL. For example, failing to provide a focus on SRL in the culmination of scores for the Australian Tertiary Admission Rank (ATAR) will likely negatively influence educators' epistemic reflexivity about SRL and will work against strategic goals aimed at fostering students' SRL (e.g., The Future of Education Strategy).

AITSL teacher professional standards and the curriculum

The AITSL Teacher Professional Standards (AITSL, 2020) and the Australian Curriculum (ACARA, 2020) play a prominent role in supporting progression toward national educational goals. However, there is substantial scope for both to better detail the expectations and evidence-based pedagogies that support the sustainability of school improvement initiatives about SRL.

Within the AITSL standards, SRL can be found under AITSL Standard 1.2 ("Understand how students learn"), as this standard requires Australian teachers to have a deep knowledge of research about the science of learning and the translation to practice. SRL can also be positioned in AITSL Standard 2.1 ("Content and teaching strategies of the teaching area"), as SRL is arguably a domain of knowledge and has specific teaching strategies that underpin it (discussed in Section 2.3.1). Within both above-mentioned standards, there is ample opportunity to provide explicit guidance for teachers seeking to promote students' SRL. This might include short video modules with examples of how students self-regulate their learning, and how teachers explicitly teach SRL strategies. This would support high quality knowledge and beliefs about SRL, which would inevitably influence the quality of teachers' epistemic cognition for teaching about SRL.

Similarly, SRL can also be found in the Australian Curriculum. For example, under the General Capability of Personal and Social Capability, SRL shares similarities with self-awareness and self-management. Within the General Capability of Creative and Critical Thinking, SRL shares numerous aspects, such as reflecting on thinking and processes (metacognition), inquiring (identifying, exploring and organising information and ideas) and generating ideas, possibilities and actions (ACARA, 2020). While the ACARA (2020) learning continuums offer a useful guide as to where students should be with their SRL by the end of different year levels, there is a lack of explicit pedagogical strategies for how teachers support their students to meet the listed progression points.

In both AITSL Standards and Australian Curriculum, there are substantial opportunities to provide greater detail about the evidence-based strategies that teachers can use to achieve these standards in the classroom. Such opportunities are evident in local government efforts to translate curriculum aims into more accessible tools for teachers (e.g., FUSE by Victorian Government). Clearly, there is a need for a framework that clearly articulates the features of high-quality teaching practice about SRL that aligns with AITSL Standards 1 and 2, and elements of the Australian Curriculum's General Capabilities.

Teacher registration processes

Australian teacher registration bodies (e.g., Victorian Institute of Teaching, ACT Teacher Quality Institute, South Australia Teacher Registration Board) require teachers to complete a set number of hours of professional education per year. For example, in the ACT, teachers are required to complete a minimum of 20 hours of professional learning per year to maintain registration. It is in the interests of teachers that teacher education providers ensure that professional education available is the best available. According to the TALIS 2018 report (OECD, 2019), only 44% of teachers report participation in highly effective forms of professional education, such as peer learning (e.g., PLC-ER) and coaching, substantially less than those attending less effective form of professional education, namely courses or seminars (76%).

Given the evidence presented in my study, and to encourage peer-learning, the Australian Government (e.g., ACT Education Directorate, Victorian Department of Education) might offer educators training in how to successfully implement the PLC-ER approach in schools and might offer facilitated PLC-ERs that focus on achieving set educational goals (e.g., SRL). National Teacher registration bodies (e.g., AITSL) could draw on my study's results to adopt a focus on sustained improvements in teachers' practice about SRL (rather than tick-the-box type professional days) and receptive online learning activities, as opposed to the generative online learning activities that dominate the market (OECD, 2019).

9.2.2. Higher education and other teacher education providers

Like practicing teachers who are required to complete professional education to maintain their teaching registration, teacher-education students are expected to successfully complete higher education courses that adequately prepare them for the teaching profession.

Researchers have advocated for the development of students' SRL skills via improved initial teacher education and continuous professional learning (Schunk & Greene, 2018). Therefore, teacher educators might include educative tools for epistemic reflexivity about SRL or use the PLC-ER about SRL approach to support enhanced course designs. Similar to the explicit teaching of SRL strategies that has been documented for students (Kistner et al., 2015), it is theoretically possible to explicitly teach the types of self-question, self-talk and self-instruction strategies that exist for teachers' high-quality epistemic reflexivity about SRL.

In Table 9.1, I offer an example, based on the DDD-D process model of SRL (see Section 2.5) including details about how this might occur with pre-service and in-service teachers.

Table 9.1. Example of explicit strategy instruction for improved epistemic reflexivity about SRL

Action	**Example**
Name the strategy	This strategy is called the *List, Like, Load and Live* strategy
Explain	As teachers, it is common for things like SRL to fall by the wayside as other demands occupy your attention. This strategy can be deployed to help bring SRL back into the limelight. It's a series of self-questions/self-instructions that you can ask yourself to ensure that SRL continues to be prioritised. *Question 1 (Discernment):* List the current concerns. Is SRL in the mix? *Question 2 (Deliberation):* Like (prioritise) the current concerns. Where does SRL fit with your school's vision, mission and values and your own personal beliefs? Can you justify SRL as a priority (important over the urgent)? *Question 3 (Decision):* Load: What learning outcome can you set for SRL? and What strategies will ensure these learning outcomes are achieved (for both you and your students)? *Question 4 (Deed):* Live: Tell yourself to "Just Do IT!"
Model	This strategy can be used when lesson planning. Teacher educator models how teachers might use this in their lesson planning.
Opportunity for practice	Teachers could practice this throughout an embedded PLC-ER in their own school context and chosen subject area.

9.2.3. Schools

PLCs are a common professional education approach in Australia (New South Wales State Government, 2019; Victoria State Government, 2019) and so PLC-ER is not a new approach as much as an available upgrade to existing structures. While many have advocated for the implementation of PLCs (Bowe & Gore, 2016; New South Wales State Government, 2019; Vescio et al., 2008), very few studies have considered the characteristics of PLCs that lead to

high-level knowledge transfer (Gaikhorst et al., 2017), with even fewer studies found in the specific context of SRL.

The present study provides the fine-grained details of how a PLC-ER is designed and implemented, ensuring that schools can benefit from this research. Furthermore, as each school is its own Complex Adaptive System (refer 1.1) and epistemic cognition is highly contextual (refer 1.4), I do not advocate that the PLC-ER model documented in this study be directly replicated in other contexts. Instead, that approach and its educative tools should be used as a starting point when conceiving of professional education for deep teacher learning. For example, in this thesis, I have reassembled current models of epistemic reflexivity as a four-moment process that teachers can explicitly engage in as a scaffold to improving their own epistemic reflexivity, problem-solving and decision making related to the explicit teaching of SRL strategies. Therefore, I view the PLC-ER as a set of guidelines/tools, a starting framework that can be malleably adjusted to the systemic context.

Schools are encouraged to develop appropriate professional education experiences that support the development of school middle-leaders' epistemic cognition about SRL or other domains of knowledge. Educational leaders might draw on the PLC-ER approach to upgrade already existing PLCs to PLC-ERs or to implement new PLC-ERs in schools.

10. LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

This chapter contains a consideration of the limitations of this research study. It also includes possibilities for areas of future research. The topics are described in the following sections.

10.1. Limitations

Thus far, I have presented a relatively optimistic picture of the changes that emerged when a school middle-leaders' PLC-ER about SRL occurs in a school. This was particularly the case for the middle-leaders who were directly involved in the PLC-ER about SRL. Such a picture needs to be tempered with an understanding of this study's limitations.

In this section, I identify several limitations to the present study that should be considered when drawing conclusions:

- Sample size and single school focus.
- Scope of lesson observations and assessment of teaching practices about SRL.
- Assessment of student SRL behaviours.

These limitations are described in the following sub-sections.

10.1.1. Sample size and single school focus

A sample size of 16 school middle-leaders is relatively small and therefore open to challenge. Some may argue that this sample size is too small to justify conclusions made about changes in middle-leaders' epistemic cognition for teaching. However, small sample sizes are expected given the nature of microgenetic studies (Chinn & Sherin, 2014; Siegler, 2006). Indeed, 16 middle-leaders was a large percentage (84%) of the available participant group. Additionally, achieving the same depth and sustained nature of data collection and analysis with a larger group of participants would have required a research team of a size unrealistic for a doctoral study.

Although the project design aimed to sample a substantial number of regular classroom teachers, the participating sample size was considerably smaller than the available participant pool. Furthermore, participation rates for matched regular classroom teachers dropped substantially 9-months after the conclusion of the PLC-ER about SRL. This drop in participation may be explained by the fact that some regular classroom teachers left the school at the end of 2018, as is common in schools (Sorensen & Ladd, 2020). Staff turnover has also been reported as a barrier to sustainability of school improvement initiatives (Turri et al., 2016). Alternatively, the middle-leader participant attrition might also have been due to conflicting beliefs between the middle-leader and that espoused by the PLC-ER about SRL, potentially a rejection of the conflicting evidence. Future studies adopting a similar focus would benefit from

different recruitment approaches that might result in larger sample sizes for the regular classroom teacher participant group, mitigating the effect of staff turnover.

A further consideration is how well the sample of middle-leaders and regular classroom teachers in the present study represents the broader population of educational leaders and teachers. Voluntary participation, while ethically appropriate, can result in a biased sample, namely, participants with an active interest and motivation in SRL. The limitation of teacher motivation in response to change has also been acknowledged in other studies (Gaikhorst et al., 2017). The quality of epistemic cognition for non-participating middle-leaders could be substantially better or worse than that reported in this study.

In addition, due to the limited sample size and as stated in Section 3.8.1, the TEC-SRL questionnaire was unable to be tested for its factor structure. This is discussed as a future research direction at Section 10.2.4.

Lastly, a granular focus on a single school context can be criticised for an inability to achieve external validity. However, achieving such validity was not the primary aim of the present study. Rather, the aim was to achieve a level of abstraction that allows theoretical generalisability. Epistemic cognition is highly context specific (Lunn Brownlee et al., 2017) and limiting focus to a single school enabled close attention to be paid to the context.

10.1.2. Scope of lesson observations and assessment of teaching practice about SRL

Lesson observations only allow a segment of a broader learning unit to be observed. For instance, when I was scheduled for a lesson observation, I was not informed of what had occurred in the prior lesson or what would happen in the following lesson. It is as Kistner et al. (2015) stated that “we [i.e., researchers] see the teacher at a certain point in time and do not know what has happened before…. For example, has the class already dealt with a certain strategy extensively and the teacher does not consider it necessary to mention it again?” (p. 192).

A classroom lesson that is scheduled later in a unit of work may offer greater opportunity for student autonomy or independent learning and the teacher may perceive it as a good opportunity to foster students’ knowledge of SRL strategies. However, in the following week, if the lesson is at the beginning of the topic, the teacher may choose to engage in a more teacher-directed transmission lesson as a scaffold to later autonomous lessons. In the present study, explicit teaching of SRL strategies was more commonly observed in lessons that included student-centred activities. While my study used a systematic approach to collect and analyse multiple videos of each middle-leader’s lessons, observation of a single lesson 9-months after the PLC-ER about SRL may not have provided a sufficient picture of changes in

middle-leaders' explicit teaching of SRL strategies, thus, reducing validity of the data and inferences drawn.

In addition, within the scope of this thesis, I have not delved into subject-specific SRL strategies that might be taught in different domains. As a foundational study exploring teachers' epistemic cognition about SRL and their associated practice, I positioned SRL strategies under the broad categories of motivation (e.g., strategies to enhance self-efficacy), cognition (rehearsal, elaboration and organisation) and metacognition (e.g., self-recording, self-talk). It was within these broad categories that observation and evaluation of teaching practice occurred.

The limitation of single lesson observations is a common challenge for educational researchers. Indeed, Dignath-van Ewijk and Veenman (2020) reported that "most [observational] studies [of teachers' SRL practices] included *only* single lessons" (p. 14, emphasis added). More recently, Karlen et al. (2020) acknowledged this barrier to accurately assessing teachers' thinking and practice, advocating that self-report measures might offer a more holistic view of teachers' habitual practice. However, given strong arguments that consistently urge researchers to move beyond solely using self-report measures (refer 3.7.1), I recommend that future research not only triangulate data between different evaluation tools, but also consider using the average of repeated measures of teachers' thinking and practice, within a dedicated period, to gain a more accurate measure of teaching practice about SRL.

Another limitation associated with the lesson observations is that classes observed 9-months after the PLC-ER were not the same year level or subject as previously observed (the year prior), instead being based on middle-leaders' class timetables and availability during the 2-week period for data collection. A change in context of class may have resulted in lower number of minutes of explicit teaching of SRL strategies being observed. This is an inherent problem with any in-school study using lesson observations, as teachers (and middle-leaders) allocated classes and timetables change with each year.

Additionally, given the context and content-specificity of epistemic cognition for teaching about SRL, a broader set of motivational, cognitive and metacognitive strategies would need to be considered that are specific to each individual subject-domain. The SRL strategies used for coding (refer Coding Manual, Appendix O) are the general SRL strategies documented in the literature. However, researchers (Winne, 2018; Zimmerman, 2008a) have suggested that different subject domains may teach these strategies in contexts in different ways and this would be a useful consideration in future studies.

Lastly, as detailed in the Method chapter (refer Section 3.8.3), videos of lessons were standardised to 45 minutes to enable fair comparison. This meant that the lesson plenary (a typical reflective component of the lesson) was often not included in the data analysis. It is possible that the lesson plenary may have included further middle-leaders' reflective prompting

or strategy instruction that was not captured in the data analysis and therefore, not reported as part of the present study. Other challenges experienced and potential limitations to the present study was that the quality of the video-recording (as the camera was set up at the back of the class) meant that at times some of the teacher-student conversations were not able to be captured. Future research would likely benefit from using new video camera technology (e.g., Swivl) to capture the teacher and student conversations more accurately. Improved video-recording technology may also mitigate some of the issues with the level of student noise experienced in many of the student-centred learning activities.

10.1.3. Assessment of student SRL behaviours

Similar to the limitation of using only a single video-recorded lesson (refer 10.1.2), this same argument may apply to the contextual nature of students' SRL Process Protocols. While students in the present study completed three SRL Process Protocols, there was a two to three week gap between each data collection point. A single SRL Process Protocol at any time point may not provide an accurate representation of students' SRL aptitude given that SRL is situated within a lesson (Michalsky, 2017; Winne & Perry, 2000). It is arguable that SRL Process Protocols would need to be completed during multiple lessons within a set period to gain a more holistic picture of students' SRL behaviours. Furthermore, the quality of students' responses to SRL Process Protocols may have also been influenced by their own motivation to complete the task and their teachers' encouragement and support during completion (including monitoring and collection of SRL Process Protocols after completion). Additionally, given arguments against self-reports for epistemic cognition documented in Section 3.7.1, students' self-reports of their SRL alone may be insufficient in forming an accurate picture of their engagement in SRL behaviours.

Results reported at Chapter 8 revealed variation in students' SRL behaviours reported in SRL Process Protocols and Metacognitive Awareness Inventories. One explanation for this variation is that the SRL Process Protocols were only used with students who had school middle-leaders as one of their teachers (as the middle-leaders administered the SRL Process Protocol). Another explanation is the variation in the middle-leaders' explicit teaching of SRL strategies (refer Chapter 6). Additionally, due to the exclusion of a control group with which to compare, neither of the student measures can reliably rule out response bias or maturation. Thus, this study acts as a pre-experimental design.

Lastly, it is also possible that changes that emerged in student SRL behaviours were stimulated from experiences beyond the participating middle-leaders' explicit teaching of SRL strategies. For example, regular classroom teachers, who did not participate in the present study may have been engaged in explicit teaching of SRL strategies. Moreover, adolescent students might be exposed to sharing of SRL strategies in their family home (i.e., from parents or siblings) or in other educational contexts beyond the school (e.g., tutoring). It is also feasible

that, during independent learning opportunities, a student may self-generate a new strategy through a process of problem-solving.

10.2. Future Directions for Research

Moving beyond the limitations discussed, results from the present study offer multiple avenues for future research:

- Capture the totality of changes that emerge in a school.
- Explore the role of middle-leaders in sustainability of school improvement initiatives about SRL.
- Perform further microgenetic evaluations of the PLC-ER and model of epistemic cognition for teaching, beyond the domain of SRL and in other educational contexts.
- Refine and test the TEC-SRL questionnaire and combine with follow-up interviews.
- Explore cognition for teaching and learning about SRL.
- Evaluate the SRL process protocols and associated rubric.

This section does not contain an exhaustive list of research possibilities. Other directions may include investigations into students' epistemic cognition about SRL and alternative enhancements to the PLC-ER to further align with theory about epistemic cognition.

10.2.1. Capture totality of changes that emerge in a school

Further research could adopt an even higher level of systems thinking (Fullan, 2006; Senge, 1990), to build a more complete picture of the "whole" school (Archer, 2003; Schneider & Somers, 2006; Stoll & Kools, 2017), including as many of its contributing parts, and how they interact with each other.

As one example, due to restrictions on resources and time inherent with a Ph.D., in capturing "totality", I chose to focus on the middle-leaders' Forethought and Performance phases of epistemic cognition for teaching about SRL (refer to 2.2.1). However, it would be beneficial to expand the focus to the Self-Reflection phase and investigate the different epistemic stances adopted by teachers and the types of epistemic products (beyond knowledge and understanding). It is as Hofer (2018) stated "more work is needed that examines this linkage [between epistemic cognition and conceptual change] at a fine-grained level" (p. 233). Furthermore, think alouds only captured some components of the DDD-D process of epistemic reflexivity. As a result, it can be concluded that further consideration of data collection tools to capture the totality of epistemic reflexivity is required.

Middle-leaders and regular classroom teachers are balancing multiple priorities, such as, teaching subject curriculum, attending to pastoral care and explicit teaching of SRL strategies.

Future research might consider the range of teachers' priorities during the *discernment* moment of epistemic reflexivity (i.e., the DDD-D model). This focus would provide greater insight into competing demands that are either imposed on or generated by teachers.

In conjunction with this more inclusive focus on the process of epistemic cognition for teaching, research should also pay attention to wider school-level factors (school policy) or external influencers (Government strategy, policy). While other studies (De Smul et al., 2018; Heirweg et al., 2020) have considered different levels of factors, these studies have not included microgenetic studies that have focussed on the process of change.

Furthermore, "totality" would also require further consideration and understanding of the dispersed effects within the school. Findings reported in Chapters 4-8 treat each participant group separately and further research could closely explore the interaction that occurred between different levels of the system. Gaining a more complete picture of the school at all time points might enable more accurate forecasts of future changes in the system (Rickles et al., 2007) and account for how leadership for change needs to work in such a system. Recently, researchers have also suggested the need for this level of systems thinking in their arguments for evaluation of SRL teaching initiatives across different student, teacher and school level factors (for example, Callan et al., 2020).

10.2.2. Explore middle-leader role in sustainability of initiatives

Research also needs to further investigate the role of school middle-leaders in sustainable school improvement, particularly in the context of SRL. In the present study, school middle-leaders engaged in varying levels of quality of epistemic cognition for teaching about SRL. However, the present study predominantly focussed on school middle-leaders who fulfilled roles related to subject-areas (e.g., Heads of Faculties) in contrast to other groups of school middle-leaders (e.g., Year level co-ordinators). School middle-leaders are heralded as the "real" drivers of change (Grootenboer et al., 2019), so it is important to move beyond research that solely focusses on senior leaders (Harris et al., 2019; Robinson, Lloyd, & Rowe, 2008) to better understand the roles of different groups of leaders (i.e., senior, middle and those who lead without formal titles), including the quality of their epistemic cognition about SRL and how they interact with other parts of the school in the context of sustainable school improvement.

In addition, there is an opportunity to explore middle-leaders' role identity and whether it aligns with the literature (i.e., "bridge and broker") and therefore, how it enables or hinders knowledge translation about SRL teaching initiatives. The PLC-ER about SRL could include an explicit focus on the middle-leaders' role identity and could promote conceptual change in order to achieve greater alignment between middle-leaders' identities and that espoused in the literature about middle-leadership. A role identity that incorporates knowledge translation can

support the sustainability of school improvement initiatives. As discussed at Section 9.1.5, knowledge translation between middle-leaders and teachers is one factor that can lead to a wider effect through the school system and, therefore, sustainability of the school improvement initiative.

Lastly, the weak distal effects observed in data collected from regular classroom teachers and students highlight the need to directly assess whether and how middle-leaders translate and disseminate professional knowledge among their teaching colleagues. For example, a future study could include a measure to evaluate whether middle-leaders' actually relayed any information learnt during the PLC-ER to their teaching teams.

10.2.3. Evaluate PLC-ER in other educational contexts

The present study conducted a microgenetic study in the context of teaching about SRL. There is therefore scope for PLC-ER to be applied in other domains of knowledge and educational contexts.

Firstly, there is a need for further microgenetic evaluations of the PLC-ER approach. By adopting a microgenetic approach to studying emergent changes, it is possible to identify change points (moments of transformation) at which educators and school engage in self-organisation. These points of emergence are inputs for the PLC-ER and may stimulate a level of self-organisation. Mapping out the process of change can lead to a deeper understanding of the sustainability of improvement initiatives, such as PLC-ER, in schools to inform future enhancements. Failure of a PLC-ER to adequately respond (i.e., when high fidelity is the goal) to changes as a result of self-organisation of the school is likely to result in a reduced likelihood of sustainability of the desired teaching initiatives. In the context of sustainability, it is more beneficial to define successful implementation not as *high-fidelity* implementation, but as changes that are *fit for purpose, people, practice and place*. Forman et al. (2013) stated "the efforts of researchers will fail to yield benefits for individuals and society unless the interventions resulting from their efforts are used in practice" (p. 78). On this basis, the present study calls for professional education approaches that are contextually appropriate and highly adaptive, capable of responding to changes that emerge within a school during implementation.

Secondly, microgenetic evaluations of the PLC-ER approach could occur in different subject domains. Optimistically, a PLC-ER might offer benefits for educators' epistemic cognition about domains such as literacy, science or other different 21st century capabilities (e.g., Critical Thinking). Furthermore, the model of epistemic cognition for teachers proposed at 2.2.1 has been extensively considered in the context of SRL. As noted at 1.4, the field of teachers' epistemic cognition is still early in its development and epistemic cognition is highly context-dependent. Therefore, it would be useful to apply the model of epistemic cognition for

teaching to different domains of knowledge to see if the model itself is easily transferable or whether modifications were required to make it more global in use, or new models specific to different domains were required. Applying this model to different domains can support a deeper understanding of the process of epistemic cognition for teaching, and the broader process of sustainability of improvement initiatives within schools.

Thirdly, further research could investigate changes that emerge with a PLC-ER about SRL in different school contexts. Schools, as Complex Adaptive Systems, are evolving at different rates (Kauffman, 1995; Schneider & Somers, 2006). As Bartelink et al. (2019) stated "the focus should be on each specific school, as each school has their own starting point and process of change" (p. 13). Utilising a PLC-ER approach in other schools would also enable specific consideration to be given to the decline reported in the present study between Weeks 12 and 52 (discussed earlier at Section 9.1.4). In addition, researchers, in collaboration with schools, might utilise the site improvement tool offered by Askell-Williams and Koh (2020).

Fourthly, future comparative studies between a PLC and a PLC-ER are recommended. I have argued that a PLC-ER about SRL has multiple benefits for middle-leaders' epistemic cognition and their teaching practice about SRL. Results reported in Chapter 5, 6 and 7 is viable evidence that the PLC-ER about SRL had an effect. However, Hattie (2009) argued that effective educational interventions produce learning improvements to a nominal effect size of Cohen's d = 0.4. Given PLCs are well-established as effective education interventions (Dogan et al., 2016; Vescio et al., 2008), there is a need for future comparative studies to firmly establish the difference in effect between a PLC and PLC-ER.

Additionally, digital learning environments are becoming increasingly common learning experiences for teachers and students. There is an opportunity for future research to consider how the foundations of a PLC-ER can be transformed or applied from face to face learning experiences into digital modes. There are opportunities to embed educative tools into learning management systems to automatically prompt teacher-learners to engage in a process of epistemic reflexivity about SRL. Better yet, artificial intelligence might enable an online PLC-ER to respond to its users, essentially co-evolving with a school. Similarly, Kerwer and Rosman (2020) have also acknowledged the opportunity for online education that focusses on developing epistemic cognition. Whether face to face or online, it is important that practicing teachers and pre-service teachers are presented an opportunity to participate in PLC-ERs.

Lastly, the PLC-ER in the present study focussed on school middle-leaders. It would be beneficial to explore changes that emerge with different groups of participants, such as regular classroom teachers or pre-service teachers. Vosniadou et al. (2020) advocated that, following their study with pre-service teachers, "most importantly, future research needs to investigate the belief systems [about SRL] with practicing teachers" (p. 15).

10.2.4. Refine and test TEC-SRL questionnaire

The TEC-SRL questionnaire was newly developed for use in the present study and requires further consideration and potential refinement and testing.

For instance, in relation to educator's epistemic ideals about SRL, Likert-scale items 15 and 17 require further thinking and rewording. Item 15 ("I know when students have achieved a deeper knowledge about SRL") may be overly complex for educators and could be rephrased and simplified for educators as "I know when a student is/is not self-regulating their learning" followed by an additional item "I know when a student has improved their self-regulated learning". Item 17 ("I use a set of criteria to evaluate whether students have achieved deeper knowledge about SRL") could also be rephrased as "I use a set of criteria to assess when students are self-regulating their learning" or "I use a set of assessment criteria to evaluate when students have improved their self-regulated learning".

The open-ended items, Item 16 ("How do you know if students have achieved deeper knowledge about SRL?") and Item 18 ("If so, what criteria do you use") ascertained more useful information about different epistemic ideals. However, responses to Item 18 typically referred to criteria they would use in their assessment tasks (e.g., "criteria for assessment depending on the task", "looking at different areas of assessment") and added little value to identification of school middle-leaders' epistemic ideals about SRL. These items might benefit from rewording to draw a broader range of responses. For example, Item 16 could be rephrased as "How do you know when a student is self-regulating their learning?".

Furthermore, it is possible to apply the "what, so what, now what" strategy (Rolfe, 2001) to teachers' epistemic ideals about SRL. For example:

- **What…** are the indicators that a student is/is not self-regulating their learning? (Self-reflection)
- **So what…** might these actions/behaviours/words indicate about the students' knowledge of SRL strategies (or knowledge of cognition and knowledge of regulation)?
- **Now what…** might you do to support this student moving forward with their SRL? (Planning)

In the present study, I focused on quality of epistemic ideals rather that the categorical nature of epistemic ideals and further research is required to develop a clearer idea of the criteria that teachers can use to assess students current and developing SRL (i.e., framework of teachers' epistemic ideals about SRL). Having a clearer framework of teachers' epistemic ideals about SRL may allow for a more extensive series of survey questions that could be used to specifically assess educators' epistemic ideals about SRL.

Likert scale items related to metacognitive regulation of epistemic cognition for teaching about SRL were adapted using items from the MAI (Schraw & Dennison, 1994) and the Metacognitive Awareness Inventory for Teachers (MAIT)(Balcikanli, 2011). On reflection, a broader set of items, with a refined focus on knowing and knowledge, may be required to collect data specifically related to metacognitive regulation of epistemic cognition for teaching about SRL, or other domains. For instance, there is scope to better integrate a more extensive set of questions that assess what Hofer (2018) referred to as "metacognitive judgements and monitoring… [where] the individual moves from 'do I know this?'… to 'how do I know this?' 'Do I judge this to be credible?' 'Is there evidence to support this claim'" (p. 230). To evaluate whether a teacher is asking such questions, a revised TEC-SRL questionnaire could include items such as "If I assess a student to be self-regulating their learning - I ask myself… how do I know this?" or "I regularly consider the quality of the students' knowledge or enacted knowledge (i.e., behaviour) about SRL".

The following modifications are also recommended:

- *Pedagogical Content Knowledge*: The open-ended item "what is the best way to teach SRL? why?" may have only prompted school middle-leaders to respond with one pedagogical strategy (i.e., the best way), limiting their responses. It would be useful to reduce the restriction of "best way", by rephrasing as "what are the different ways to teach SRL?", then following this question, it would be worthwhile asking "which of these is the best way to teach SRL? why?"
- *Epistemic value about SRL*: The Likert Scale item "it is important to develop students' knowledge about SRL" could be followed by an item that compares epistemic value about SRL with their regular discipline. For example, "developing students' knowledge about SRL is equal in importance to developing their knowledge about [subject-domain]". Another recommendation would be to include suitable questions to differentiate between the four dimensions of Eccles & Wigfield's (2002) Expectancy value theory.
- *Beliefs about certainty*: The current version of the TEC-SRL does not include items about beliefs about the certainty of knowledge. As stated in 2, I chose those knowledge and belief factors that were most pertinent to the present study. However, future versions of the TEC-SRL might include items that measure beliefs about the stability of knowledge, such as the Beliefs about the Certainty of Teaching Knowledge (BECK) scale espoused by Ferguson and Lunn Brownlee (2018). Addition of items will need to be considered in the total length of the TEC-SRL, or alternatively, several sub-scales formed.
- *Beliefs about the source of knowledge*: TEC-SRL Item 4 (Knowledge of how to self-regulate learning comes from the teachers) was intended to determine how the middle-leaders or teachers viewed their roles in fostering students' SRL knowledge. However, during

analysis, it became clear that the middle-leaders' and teachers' responses to this item did not clearly indicate whether middle-leaders or teachers held a transmissive belief or constructivist-supported beliefs. Therefore, Item 4 needs to be reconsidered to clearly acknowledge the different constructivist orientations (e.g., constructivist-supported vs. constructivist-autonomous beliefs). Similarly, TEC-SRL item 5 (Knowledge of how to self-regulate learning comes from a student's own personal construction) needs to be further considered as the item does not differentiate whether the student is constructing this knowledge in a teacher-supported environment, or on their own in an autonomous circumstance.

Lastly, there is a need to test the TEC-SRL questionnaire with a larger sample in order to determine its factor structure. Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) would further determine the validity of the TEC-SRL questionnaire in evaluating different aspects of teachers' epistemic cognition, as well as preparing the TEC-SRL questionnaire for future predictive studies.

10.2.5. Explore epistemic cognition for teaching and learning about SRL

An avenue for future research is to further investigate educators' epistemic cognition and its sub-components for teaching about SRL.

For example, further research is required to better understand the role of epistemic value about SRL in the process of epistemic reflexivity about SRL. According to results reported in Chapters 4, 5 and 6, a misalignment was documented between middle-leaders' self-reported epistemic value and the epistemic value evident through their epistemic reflexivity and subsequent observed teaching practice. This misalignment was no surprise given knowledge of espoused theories and theories in action (Schön, 1987). In many ways, epistemic reflexivity is what Berkman et al. (2017) explained as a "*value-based choice* wherein options are assigned a subjective value and a decision is made through a dynamic integration process" (p. 422). The question for researchers is not how to increase teachers' epistemic value for SRL, but how to promote teachers' epistemic value among other priorities, and ensure that such epistemic value translates into practice? It is as Hargreaves and Fink (2005) stated that ''sustainability does not simply mean whether something will last. It addresses how particular initiatives can be developed without compromising the development of others in the surrounding environment" (p. 30). Therefore, an interesting direction would be to explore the types of tasks that teachers prioritise when engaged in epistemic reflexivity during lesson planning and whether teaching for SRL is prioritised in this instance. If it is listed as one of their priorities, then how can the teaching of SRL be shifted up in priority without compromising other priorities? This is not an ambivalent case of "or", but rather how can teachers prioritise SRL *and* still maintain their other priorities. It is what Shaked (2020), building on the work of Pearce, Wassenaar, Berson, and Tuval-Mashiach (2019) and Zhang and Han (2019), referred to as paradoxical leadership

behaviour that involves “a ‘both/and’ approach, which supports contradictory elements simultaneously by leveraging the advantages of each option separately and building on their synergistic potential” (p. 1637). This argument is also supported by studies that have documented *competing initiatives* as a major barrier to sustainability of school improvement initiatives, and advocated for strategies to mitigate it (Turri et al., 2016).

Studies might investigate teachers’ epistemic ideals about SRL and develop a framework of teachers’ epistemic ideals about SRL, as highlighted in Section 2.3.3, very little is known about these ideals. Results from the present study demonstrate that such ideals require greater exploration. For example, drawing on a developmental perspective (for example, King & Kitchener, 1994; King & Kitchener, 2004), and as I argued in Section 2.3.3, as adults, it was expected that school middle-leaders would rely less on methods of observation and unfounded personal opinions and more on inquiry and consistent engagement with multiple sources of evidence to justify their claims about students’ SRL knowledge. The alternative explanation for this finding is that middle-leaders possess *alternative epistemologies* (Chinn et al., 2020): a different set of epistemic ideals to those I have proposed based on my review of the literature about epistemic ideals (refer to Section 2.3.3, Table 2.1). Therefore, it is possible that, in the context of teaching about SRL, middle-leaders viewed “observation” as a reliable method for establishing a knowledge claim (i.e., whether their students were engaged in SRL or not).

The need for further investigation into how educators assess students’ SRL and the quality of their epistemic ideals about SRL has been acknowledged in recent studies (Callan et al., 2020; Dignath-van Ewijk & Veenman, 2020). Chinn and Rinehart (2016) advocated that future research “investigate what people perceive as reliable and unreliable processes for producing knowledge, theories, understanding, and other epistemic products” (p. 471). Epistemic ideals have also been noted as an important future direction by Lunn Brownlee et al. (2019). Teachers are pragmatic beings and developing a framework of epistemic ideals about SRL (i.e., a clear set of criteria for students’ knowledge about SRL) and the processes to developing and assessing students’ SRL would be beneficial in supporting the development of educators’ content and pedagogical content knowledge about SRL and, more broadly, their process of epistemic cognition. Essentially, it seems particularly important that teachers can accurately identify when a student possesses a high-quality knowledge about SRL (or not), so that appropriate teaching approaches can be implemented to support students’ progress. To achieve a deeper understanding of teachers’ epistemic ideals about SRL, it would be useful to further refine the TEC-SRL (as indicated at 10.2.4) and to add to TEC-SRL items with interviews and to negotiate time-arrangements with school beforehand.

Lastly, the present study focussed on educator’s epistemic cognition for teaching about SRL. There is an opportunity to incorporate students’ epistemic cognition for learning about SRL in evaluation studies. Numerous studies have occurred about epistemic cognition for

learning in science (Inagaki & Hatano, 2013; Stathopoulou & Vosniadou, 2007; Vosniadou et al., 2001), reading (Ferguson, Bråten, & Strømsø, 2012) and mathematics (Muis, 2004), with few occurring in domain of SRL. In a recent meta-analysis, Cartiff et al. (2020) explored the effect of epistemic cognition interventions on academic achievement. From their analyses of 26 experimental and quasi-experimental studies, they reported that "epistemic cognition interventions had a statistically significant, medium-level effect on academic achievement (Cohen's $d = 0.509$, $p < .001$)" (p. 1). Indeed, Cartiff et al. called for studies that consider the "lasting effects" (p. 17) of epistemic cognition interventions with students.

10.2.6. Evaluate SRL process protocols and rubric

The SRL Process Protocol and rubric would benefit from further consideration, reworking and testing with teachers and students. For example, a greater differentiation in items and coding (by way of the rubric) is required to enable better comparison of scores between students. Specifically, coding of Performance items (e.g., Am I managing my time?) resulted in typically high scores for a large majority of the students due to the number of closed ended items (i.e., "yes"/"no") that yielded little differentiation. In other words, little effort/information was required to attain points in that section and therefore provided little information about how students engaged in the performance phase of SRL. Items about evaluation of success ("What was the reason for my success/failure?") typically drew responses related to resource-management for time and distractions. It may be useful to provide students with some options so they can begin to see other causes for their success.

Analysis of students' SRL Process Protocols over time indicated that students may have lost interest in completing the sheet as time went on. This lost interest might be due to students feeling they were already self-regulating their learning and did not feel the need to complete their sheets or that they simply did not enjoy or have interest in completing the sheet. As I was not present in lessons when the SRL Process Protocol was administered, it was difficult to ascertain the level of middle-leader instructions that accompanied the SRL Process Protocol in each classroom. Further research could explore the influence of explicit instruction for how to use an SRL Process Protocol in classrooms occurring during a PLC-ER and to explore teachers' and students' experience of using an SRL Process Protocol. In terms of coding the rubric, it would also be beneficial to code the written goals and strategies for quality and then compare by Year level, enabling any year-level patterns to emerge.

Overall, an SRL Process Protocol may be better utilised as a set of metacognitive prompts for both teacher and student, rather than solely being a student completed worksheet. As an example of this change, Askell-Williams et al. (2012) used a metacognitive worksheet as both a classroom working tool, an assessment tool and as a data collection instrument. A teacher could use an SRL Process Protocol to explicitly teach certain aspects of each phase. For example, in one lesson a teacher might teach a goal setting strategy and use an SRL Process

Protocol as a space for students to apply a newly taught goal-setting strategy. The teacher could then utilise the SRL Process Protocol as an assessment mechanism to determine how students engaged in goal setting and the quality of application of the newly learnt strategy.

11. CONCLUDING STATEMENT

Concerns raised about the sustainability of school improvement initiatives (Koh & Askell-Williams, 2020), particularly in the field of SRL (De Smul et al., 2018; Heirweg et al., 2020) continue to be a prominent issue in education. Sustainable school improvement about SRL is an adaptive challenge, a challenge with unclear problems and solutions that can only be solved on the ground (Fullan, 2005; Heifetz, 2009). To better understand sustainability of school improvement initiatives about SRL, the present study investigated the understudied yet important role of school middle-leaders and their epistemic cognition for teaching about SRL. Through this investigation, I advanced a model of epistemic cognition for teaching about SRL and a process model of epistemic reflexivity for teaching about SRL. Furthermore, drawing on the field of conceptual change, specifically PLCs and epistemic reflexivity, I conceived of a superior PLC – the PLC-ER – designed to stimulate change in an educator's epistemic cognition. Lastly, I explored the emergent changes in a school when middle-leaders' participated in a PLC-ER about SRL.

Results revealed that prior to a PLC-ER about SRL, school middle-leaders' epistemic cognition and resultant teaching practice about SRL, teachers' beliefs about SRL and students' SRL behaviours were all less than optimal. Following middle-leaders' participation in a PLC-ER about SRL, significant improvements occurred in middle-leaders' epistemic cognition for teaching and subsequent teaching practice about SRL and in students' SRL behaviours.

Analysis of changes revealed that:

- Epistemic reflexivity is an influencing variable between knowledge and beliefs and sustainable practice.
- A structural prompt is required to support sustainable change.
- Knowledge translation from middle-leaders to regular classroom teachers depends on middle-leaders' role identity and support from senior leadership.

Overall, results showed that the PLC-ER about SRL is an approach that can stimulate proximal improvements for those directly involved, as well as dispersed effects for students' SRL behaviours. However, further research is required to confirm distal changes and dispersed effects for teachers' beliefs about SRL.

This study demonstrates that, when schools are conceived of as Complex Adaptive Systems and that sustainability is defined as an emergent, unpredictable and potentially impermanent product of the system, incorporating conceptual change approaches into professional education (e.g., PLC-ER) can promote high quality epistemic cognition for teaching. The PLC-ER about SRL enabled middle-leaders to develop a deep knowledge about SRL, to engage critically with this knowledge amid their multiple working contexts and to make

professional decisions about teaching about SRL. The PLC-ER about SRL enhanced middle-leaders' high-quality epistemic reflexivity and, therefore, their epistemic cognition.

The dissemination activities that I propose following the finalisation of the thesis examination process include:

- Incorporation of a PLC-ER model into a new research project (ethics application submitted and grant funding confirmed).
- Incorporation of educative tools from the PLC-ER approach into my own teacher education courses.
- Contributions to teacher education blogs.
- Presentations to local schools.
- Presentations at national and international conferences.
- Submissions to education authorities and governments.
- Publication in national and international journals.

It is my hope that the Australian Government, key education bodies, Higher Education and schools draw upon the reported empirical evidence and implications regarding the PLC-ER approach in order to develop similar professional education experiences that promote high quality epistemic cognition for teaching about SRL. The outcomes of such professional education offer a pathway to sustainable school improvement that incorporates the teaching of SRL and therefore an avenue to realising important goals on local and global agendas (ACT Education Directorate, 2018; Education Council, 2019).

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APPENDICES

Appendix A. Verbal Scripts

Verbal Script to recruit / contact – for **school middle-leaders**

My name is Shyam Barr and I am undertaking a Doctor of Philosophy at Flinders University. As part of my studies I am investigating processes that influence the sustainability of a teaching approach about self-regulated learning.

Over the next 12 weeks, I will ask you to help me with my research into this teaching approach about self-regulated learning by:

- Engaging in six professional learning sessions related to the self-regulated learning teaching approach, including collaborating with me to consider the self-regulated learning teaching approach and its method of implementation with your classes. This will include the recording of think-alouds while planning regular lessons.
- Implementing the self-regulated learning teaching approach with your respective classes.
- Participating in three questionnaires and three individual interviews at the beginning of Semester 1 2018, end of Semester 1 2018 and end of Semester 1 2019, regarding your knowledge, beliefs and practice about the self-regulated learning teaching approach, and your perceptions of the barriers to its sustained implementation.
- Lastly, allowing me to video-record six lessons (one before the professional development program commences, three during the professional development program, and two after) regarding your classroom teaching practices related to self-regulated learning.

Later, I will write a report about my research and give it to the appropriate university examiners to mark. If any publications arise from my research, no individuals or sites will be named, nor recognisable.

All participation is voluntary and confidential and you are able to withdraw from participating at any time.

Today, I am going to provide you a letter of introduction, an information letter regarding my research and a consent form that you will be able to complete online in order to participate. It is entirely up to you whether you choose to participate in my research project. By completing the online consent form, you will be allowing me to use your data/results as part of my investigation.

Verbal Script to recruit / contact – for **students within school middle-leaders' classes**

My name is Shyam Barr and I am undertaking a Doctor of Philosophy at Flinders University. As part of my studies I am investigating students' self-regulated learning.

I will ask you to help me with my research by:

- Completing and submitting a one-page worksheet designed to record your self-regulated learning at three different times throughout Semester 1.
- Completing a short questionnaire at the beginning of Semester 1 2018, end of Semester 1 2018 and again at the end of Semester 1 2019, regarding your learning.

Later, I will write a report about my research and give it to the appropriate university examiners to mark.

If any publications arise from my research, no individuals or sites will be named, nor recognisable. All participation is voluntary and confidential.

Today, I am going to provide you a letter of introduction, an information letter regarding my research and a consent form that you will be able to complete online in order to participate. It is entirely up to you whether you choose to participate in my research project. By completing the online consent form, you will be allowing me to use your data/results as part of my investigation.

Verbal Script to recruit / contact – for **regular classroom teachers**

The Principal (or delegate) will be asked to share the following information with teachers.

{Insert relevant school name} is currently working with Shyam Barr, who is undertaking a Doctor of Philosophy at Flinders University. As part of his research he is investigating processes that influence the sustainability of a teaching approach about self-regulated learning.

He is going to ask each of you to help with his research by completing a short questionnaire at the beginning of Semester 1 2018, end of Semester 1 2018 and again at the end of Semester 1 2019, regarding your learning.

You will receive an email from Shyam over the coming days, with full details of his research project and how you can participate.

Verbal Script to recruit / contact – for **students within regular classroom teachers' classes**

Classroom teachers will be asked to share the following information with their students.

{Insert relevant school name} is currently working with Shyam Barr, who is undertaking a Doctor of Philosophy at Flinders University. As part of his studies he is investigating students' self-regulated learning.

He is going to ask each of you to help with his research by completing a short questionnaire at the beginning of Semester 1 2018, end of Semester 1 2018 and again at the end of Semester 1 2019, regarding your learning.

You and your parents will receive an email from Shyam over the coming days, with full details of his research project and how you can participate.

Appendix B. Letters of introduction

College of Education, Psychology and Social Work

Room 5.41 Education Building

GPO Box 2100
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Tel: 08 8201 5671
helen.askell-williams@flinders.edu.au

http://www.flinders.edu.au/people/helen.askell-williams

Date

LETTER OF INTRODUCTION
(for school middle-leaders)

Dear {Middle-leaders}

This letter is to introduce Shyam Barr who is a Doctor of Philosophy student in the College of Education, Psychology and Social Work at Flinders University. He will produce his student card, which carries a photograph, as proof of identity.

He is undertaking research leading to the production of a thesis or other publications on the subject of teaching and learning.

I would like to invite you to assist with this research project by agreeing to be involved in six 2-hour professional learning sessions over a period of twelve weeks (one session per fortnight) related to a self-regulated learning (SRL) teaching approach. These sessions will be incorporated into your regular professional development program. The six sessions will include group discussions where you will reflect on your experiences of the weekly trialled in-class SRL teaching approach, engage with new knowledge and record think-aloud protocols while engaged in lesson planning. You will also be asked to contribute suggestions for improvement to the SRL teaching approach for delivery in lessons over the following weeks. In between each professional learning session, you will be required to implement the SRL teaching approach with your respective classes. During the professional development period, Shyam will conduct three video-recorded lesson observations as a method to provide you with feedback related to the implementation of the SRL teaching approach.

Additionally, at the beginning of Semester 1 2018, the end of Semester 1 2018, and the end of Semester 1 2019, you will be asked to complete a questionnaire (approximately 30 minutes) and participate in a 45 minute audio-recorded interview. The questionnaires and interviews will explore your knowledge, beliefs and practices about SRL, and your experience of the SRL teaching approach in your classroom. Furthermore, Shyam will video-record three more of your lessons as a method to gather pre- and post- information about your teaching practice about SRL. Shyam will take notes of all responses during all sessions. You may check all notes and transcriptions of interviews to ensure accuracy and clarify any potential researcher misunderstandings. No more than two hours on any one occasion would be required.

Shyam intends to document the data collected from the research components listed above in preparation of his thesis and other publications on condition that your name or identity is not revealed. He will seek your consent via the Microsoft Forms link attached to this email. Be assured that any information provided will be treated in the strictest confidence and none of the participants will be individually identifiable in the resulting report or other publications. You are, of course, entirely free to discontinue your participation at any time or decline to answer questions.

It may be necessary to make the recording available to secretarial assistants (or a transcription service) for transcription, in which case be assured that such persons will be asked to sign a confidentiality agreement which outlines the requirement that your name or identity not be revealed and that the confidentiality of the material is respected and maintained.

Any enquiries you may have concerning this project should be directed to me at the above address or by telephone on 08 8201 5671, or e-mail helen.askell-williams@flinders.edu.au.

Thank you for your attention and assistance.

Yours sincerely

Associate Professor Helen Askell-Williams

Director, Flinders Educational Futures Research Institute

College of Education, Psychology and Social Work

This research project has been approved by the Flinders University Social and Behavioural Research Ethics Committee (Project number: 7863). For more information regarding ethical approval of the project the Executive Officer of the Committee can be contacted by telephone on 8201 3116, by fax on 8201 2035 or by email human.researchethics@flinders.edu.au

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CRICOS Provider No. 00114A

Date

LETTER OF INTRODUCTION

(for students within middle-leaders' classes)

Dear Students

This letter is to introduce Shyam Barr who is a Doctor of Philosophy student in the College of Education, Psychology and Social Work at Flinders University. He will produce his student card, which carries a photograph, as proof of identity.

He is undertaking research leading to the production of a thesis or other publications on the subject of teaching and learning.

I would like to invite you to assist with this research project by agreeing to complete a student worksheet at three different times during the first semester of 2018. The worksheet will be given to you by your teachers and will be paired with an appropriate subject learning activity (e.g. science experiment, mathematics project, reading for English). The worksheets will require you to respond to some brief questions about your self-regulated learning.

Shyam Barr intends to document the responses collected from the worksheets in preparation of his thesis and other publications on condition that your name or identity is not revealed. He will seek your consent via the Microsoft Forms link attached to this email.

Be assured that any information provided will be treated in the strictest confidence and none of the participants will be individually identifiable in the resulting thesis, report or other publications. You are, of course, entirely free to discontinue your participation at any time or decline to answer questions.

Any enquiries you may have concerning this project should be directed to me at the address given above or by telephone on 08 8201 5671, or e-mail helen.askell-williams@flinders.edu.au.

Thank you for your attention and assistance.

Yours sincerely

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CRICOS Provider No. 00114A

Date

LETTER OF INTRODUCTION

(for teachers)

Dear Teachers

This letter is to introduce Shyam Barr who is a Doctor of Philosophy student in the College of Education, Psychology and Social Work at Flinders University. He will produce his student card, which carries a photograph, as proof of identity.

He is undertaking research leading to the production of a thesis or other publications on the subject of teaching and learning.

I would like to invite you to assist with this research project by agreeing to complete a short questionnaire at the beginning of Semester 1 2018, end of Semester 1 2018 and, end of Semester 1 2019. The questionnaire will take approximately 10-15 minutes to complete each time. Questionnaire responses will be used to understand teachers' knowledge, beliefs and practices about self-regulated learning. Consent to use data is assumed by completion of the questionnaire.

Be assured that any information provided will be treated in the strictest confidence and none of the participants will be individually identifiable in the resulting thesis, report or other publications. You are, of course, entirely free to discontinue your participation at any time or decline to answer questions.

Any enquiries you may have concerning this project should be directed to me at the address given above or by telephone on 08 8201 5671, or email helen.askell-williams@flinders.edu.au.

Thank you for your attention and assistance.

Yours sincerely

Associate Professor Helen Askell-Williams

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Date

LETTER OF INTRODUCTION

(for students)

Dear Students

This letter is to introduce Shyam Barr who is a Doctor of Philosophy student in the College of Education, Psychology and Social Work at Flinders University. He will produce his student card, which carries a photograph, as proof of identity.

He is undertaking research leading to the production of a thesis or other publications on the subject of teaching and learning.

I would like to invite you to assist with this research project by agreeing to complete a short questionnaire at the beginning of Semester 1 2018, end of Semester 1 2018 and, end of Semester 1 2019. The questionnaire will take approximately 10-15 minutes to complete each time. Questionnaire responses will be used to understand your self-regulated learning. Consent to use data is assumed by completion of the questionnaire.

Be assured that any information provided will be treated in the strictest confidence and none of the participants will be individually identifiable in the resulting thesis, report or other publications. You are, of course, entirely free to discontinue your participation at any time or decline to answer questions.

Any enquiries you may have concerning this project should be directed to me at the address given above or by telephone on 08 8201 5671, or e-mail helen.askell-williams@flinders.edu.au.

Thank you for your attention and assistance.

Yours sincerely

Associate Professor Helen Askell-Williams

Director, Flinders Educational Futures Research Institute

College of Education, Psychology and Social Work

This research project has been approved by the Flinders University Social and Behavioural Research Ethics Committee (Project number: 7863). For more information regarding ethical approval of the project the Executive Officer of the Committee can be contacted by telephone on 8201 3116, by fax on 8201 2035 or by email human.researchethics@flinders.edu.au

College of Education, Psychology and Social Work

Room 5.41 Education Building

GPO Box 2100
Adelaide SA 5001

Tel: 08 8201 5671
helen.askell-williams@flinders.edu.au

http://www.flinders.edu.au/people/helen.askell-williams

CRICOS Provider No. 00114A

Date

LETTER OF INTRODUCTION

(for parents)

Dear Parents

This letter is to introduce Shyam Barr who is a Doctor of Philosophy student in the College of Education, Psychology and Social Work at Flinders University. He will produce his student card, which carries a photograph, as proof of identity.

He is currently undertaking research leading to the production of a thesis or other publications on the subject of teaching and learning.

I would like to invite you to assist with this project by allowing your child to participate in his research. Shyam will invite students to complete a short-questionnaire at the beginning of Semester 1 2018, end of Semester 1 2018 and, end of Semester 1 2019. The questionnaire will take approximately 10-15 minutes to complete each time. Questionnaire responses will be used to understand students' self-regulated learning. Student consent to use data will be assumed by completion of the questionnaire.

At different times throughout Semester 1, 2018, and as part of his/her normal classroom learning activities, your child may also be invited to complete a 1-page worksheet designed to prompt and record your child's self-regulated learning.

Shyam intends to document the data collected from these questionnaires and worksheets in preparation of his thesis and other publications on condition that your child's name or identity is not revealed. He will seek your consent via the Microsoft Forms link attached to this email. Please be assured that any information provided by your child will be treated in the strictest confidence and none of the participants will be individually identifiable in the resulting thesis, report or other publications. You are, of course, entirely free to discontinue your child's participation at any time.

Any enquiries you may have concerning this project should be directed to me at the address given above or by telephone on 08 8201 5671, or e-mail helen.askell-williams@flinders.edu.au.

Thank you for your attention and assistance.

Yours sincerely

Associate Professor Helen Askell-Williams

Director, Flinders Educational Futures Research Institute

College of Education, Psychology and Social Work

This research project has been approved by the Flinders University Social and Behavioural Research Ethics Committee (Project number: 7863). For more information regarding ethical approval of the project the Executive Officer of the Committee can be contacted by telephone on 8201 3116, by fax on 8201 2035 or by email human.researchethics@flinders.edu.au

inspiring achievement

ABN 65 524 596 200 CRICOS Provider No. 00114A

Appendix C. Information Sheets

INFORMATION SHEET
(for school middle-*leaders*)

Title: Exploring teachers' knowledge, beliefs and practice about self-regulated learning

Researcher
Mr Shyam Barr
College of Education, Psychology and Social Work
Flinders University
Tel: 0421 479 959

Supervisors
Associate Professor Helen Askell-Williams
College of Education, Psychology and Social Work
Flinders University
Tel: 08 8201 5671

Professor Janice Orrell
College of Education, Psychology and Social Work
Flinders University
Tel: TBC

Dr. Mirella Wyra
College of Education, Psychology and Social Work
Flinders University
Tel: 08 8201 2392

Description of the study
This study is part of the project titled 'Exploring teachers' knowledge, beliefs and practice about self-regulated learning'. This project will investigate teachers' knowledge, beliefs and practice about self-regulated learning (SRL). This project is supported by Flinders University, College of Education, Psychology and Social Work.

Purpose of the study
This project aims to find out if changes in teachers' knowledge and beliefs lead to sustained implementation of an SRL teaching approach.

What will I be asked to do?
You will participate in six 2-hour professional learning sessions over a period of twelve weeks (as part of your regular school professional development program). You will be asked to share your reflections of the SRL teaching approach and collaborate with the researcher to plan implementation with your classes. Additionally, between each session, you will implement the SRL teaching approach as per the agreed implementation plan.

At the beginning of Semester 1 2018, end of Semester 1 2018 and, end of Semester 1 2019, you will participate in a series of questionnaires, interviews, thinking-aloud and lesson observations related to your experience of the SRL teaching approach.
Participation is entirely voluntary.

Thinking-aloud
During the professional development sessions, you will record a think-aloud protocol while you plan one of your scheduled lessons. A think-aloud is a concurrent verbal reports (participants verbalise their thoughts, feelings and cognitive processes) while performing a task.

Questionnaires
You will complete a questionnaire regarding your views about SRL. The questionnaire should take approximately 30 minutes to complete.

Interviews
You will attend a one-on-one interview with a researcher who will ask you to share more information about your views around SRL. The interview will take about 45 minutes. The interview will be audio recorded using a digital voice recorder to help with reviewing the results. Once recorded, the interview will be transcribed and stored as a computer file, and will only be destroyed if the transcript is checked by the participant.

Note: You may answer 'no comment' or refuse to answer any questions, and you are free to withdraw from the research components listed above at any time without effect or consequence.

Lesson observations
Lastly, you will have three lessons video-recorded as a method to collect pre- and post- data about your teaching practice related to SRL. Lessons will be recorded using an appropriate video recording device to help with reviewing the results. The researcher will also conduct three separate video-recorded lesson observations throughout the duration of the professional development program to assist you with implementing the SRL teaching approach. You will receive verbal feedback related to your explicit teaching of SRL directly after each lesson.

What benefit will I gain from being involved in this study?
You will receive professional development related to evidence-based teaching strategies that promote SRL in the classroom. Additionally, the sharing of your experience will improve the likelihood of sustained implementation of explicit teaching about SRL in regular classrooms.

Will I be identifiable by being involved in this study?
No. Prior to thesis submission or any form of publication, any identifying information will be removed, and your comments will not be linked directly to you. All information and results obtained in this study will be stored in a secure way, with access restricted to the listed researchers.

Are there any risks or discomforts if I am involved?
Other members of the group may be able to identify your contributions even though they will not be directly attributed to you; however, group members will be reminded of confidentiality. There will be a commitment of time for the questionnaires, interviews and professional development sessions. Questionnaires and interviews will be undertaken at a time that suits you.

How do I agree to participate?
Participation is voluntary. A link to the Consent Form (via Microsoft Forms) can be found in the same email as this information sheet. If you agree to participate, please indicate so in the Consent Form, and submit.

How will I receive feedback?
On project completion, outcomes of the project will be given to all participants via email.

Thank you for taking the time to read this information sheet, and we hope that you will accept our invitation to be involved.

This research project has been approved by the Flinders University Social and Behavioural Research Ethics Committee (Project number: 7863).
For more information regarding ethical approval of the project only, the Executive Officer of the Committee can be contacted by telephone on (08) 8201 3116, by fax on (08) 8201 2035, or by email to human.researchethics@flinders.edu.au

INFORMATION SHEET

(for *students within school middle-leaders' classes*)

Title: Investigating teaching strategies for student self-regulated learning

Researcher
Mr Shyam Barr
College of Education, Psychology and Social Work
Flinders University
Email: shyam.barr@flinders.edu.au

Supervisors
Associate Professor Helen Askell-Williams
College of Education, Psychology and Social Work
Flinders University
Tel: 08 8201 5671

Professor Janice Orrell
College of Education, Psychology and Social Work
Flinders University
Tel: TBC

Dr. Mirella Wyra
College of Education, Psychology and Social Work
Flinders University
Tel: 08 8201 2392

Description of the study
This study is part of the project titled 'Investigating teaching strategies about self-regulated learning' This project will investigate the effect of different teaching strategies on student self-regulated learning (SRL). This project is supported by Flinders University, College of Education, Psychology and Social Work.

Purpose of the study
This project aims to find out how different teaching strategies influence student SRL.

What will I be asked to do?
You are invited to assist with this research project by agreeing to complete a student worksheet at three different times during the first semester of 2018. The worksheet will be given to you by your teachers and will be paired with an appropriate subject learning activity (e.g. science experiment, project, reading). The worksheet will require you to respond to some brief prompts about your learning in the moment.

What benefit will I gain from being involved in this study?
The worksheet is designed to prompt students to engage in the process of SRL.

Will I be identifiable by being involved in this study?
No, any identifying information will be removed, and your comments will not be linked directly to you. All information and results obtained in this study will be stored in a secure way, with access restricted to the listed researchers.

Are there any risks or discomforts if I am involved?
No risks or discomforts are noted.

How do I agree to participate?
Participation is voluntary. You may answer 'no comment' or refuse to answer any questions, and you are free to withdraw from the research components listed above at any time without effect or consequences. A link to the consent form can be found in the same email as this information sheet. If you agree to participate please indicate so in the online Consent Form and submit.

How will I receive feedback?
On project completion, outcomes of the project will be given to all participants via email.

Thank you for taking the time to read this information sheet, and we hope that you will accept our invitation to be involved.

This research project has been approved by the Flinders University Social and Behavioural Research Ethics Committee (Project number: 7863).
For more information regarding ethical approval of the project only, the Executive Officer of the Committee can be contacted by telephone on (08) 8201 3116, by fax on (08) 8201 2035, or by email to human.researchethics@flinders.edu.au

INFORMATION SHEET
(for regular classroom *teachers*)

Title: Exploring teachers' knowledge, beliefs and practice about self-regulated learning

Researcher
Mr Shyam Barr
College of Education, Psychology and Social Work
Flinders University
Tel: 0421 479 959

Supervisors
Associate Professor Helen Askell-Williams
College of Education, Psychology and Social Work
Flinders University
Tel: 08 8201 5671

Professor Janice Orrell
College of Education, Psychology and Social Work
Flinders University
Tel: TBC

Dr. Mirella Wyra
College of Education, Psychology and Social Work
Flinders University
Tel: 08 8201 2392

Description of the study
This study is part of the project titled 'Exploring teachers' knowledge, beliefs and practice about self-regulated learning' This project will investigate teachers' knowledge, beliefs and self-reported teaching practice related to self-regulated learning (SRL). This project is supported by Flinders University, College of Education, Psychology and Social Work.

Purpose of the study
This project aims to find out if changes in teachers' knowledge and beliefs lead to sustained implementation of a teaching approach about SRL more broadly within the school.

What will I be asked to do?
You are invited to assist with this research project by agreeing to complete a short-questionnaire at the beginning of Semester 1 2018, end of Semester 1 2018 and, end of Semester 1 2019. The questionnaire will take approximately 10-15 minutes to complete each time. Questionnaire responses will be used to understand your knowledge, beliefs and practices related to SRL.

What benefit will I gain from being involved in this study?
The sharing of your experiences will improve the likelihood of sustained implementation of explicit teaching about SRL in regular classrooms.

Will I be identifiable by being involved in this study?

No. Any identifying information will be removed, and your comments will not be linked directly to you. All information and results obtained in this study will be stored in a secure way, with access restricted to the listed researchers.

Are there any risks or discomforts if I am involved?
There will be a commitment of time for the completion of the questionnaires, but this has been taken into consideration in the construction of questionnaire items. Additionally, questionnaires will be able to be completed at a time suitable to you.

How do I agree to participate?
Participation is voluntary. You may answer 'no comment' or refuse to answer any questions, and you are free to withdraw from the research components listed above at any time without effect or consequences. Consent to use data is assumed by completion of the questionnaire.

How will I receive feedback?
On project completion, outcomes of the project will be given to all participants via email.

Thank you for taking the time to read this information sheet, and we hope that you will accept our invitation to be involved.

This research project has been approved by the Flinders University Social and Behavioural Research Ethics Committee (Project number: 7863).
For more information regarding ethical approval of the project only, the Executive Officer of the Committee can be contacted by telephone on (08) 8201 3116, by fax on (08) 8201 2035, or by email to human.researchethics@flinders.edu.au

INFORMATION SHEET

(for *students* within *regular classroom teachers' classes*)

Title: Investigating teaching strategies for student self-regulated learning

Researcher
Mr Shyam Barr
College of Education, Psychology and Social Work
Flinders University
Email: shyam.barr@flinders.edu.au

Supervisors
Associate Professor Helen Askell-Williams
College of Education, Psychology and Social Work
Flinders University
Tel: 08 8201 5671

Professor Janice Orrell
College of Education, Psychology and Social Work
Flinders University
Tel: TBC

Dr. Mirella Wyra
College of Education, Psychology and Social Work
Flinders University
Tel: 08 8201 2392

Description of the study
This study is part of the project titled 'Exploring teachers' knowledge, beliefs and practice about self-regulated learning'. This project will investigate changes in teachers' knowledge, beliefs and teaching practice related to self-regulated learning (SRL). This project is supported by Flinders University, College of Education, Psychology and Social Work.

Purpose of the study
This study aims to find out how different teaching strategies influence students' SRL.

What will I be asked to do?
You are invited to assist with this research project by agreeing to complete a short-questionnaire at the beginning of Semester 1 2018, end of Semester 1 2018 and, end of Semester 1 2019. The questionnaire will take approximately 10-15 minutes to complete each time. Questionnaire responses will be used to understand student SRL

What benefit will I gain from being involved in this study?
Your teachers will receive information about the levels of student SRL at the school which may inform their teaching.

Will I be identifiable by being involved in this study?
No, any identifying information will be removed, and your comments will not be linked directly to you. All information and results obtained in this study will be stored in a secure way, with access restricted to the listed researchers.

Are there any risks or discomforts if I am involved?
No risks or discomforts have been identified.

How do I agree to participate?
Participation is voluntary. You may answer 'no comment' or refuse to answer any questions, and you are free to withdraw from the research components listed above at any time without effect or consequences. Consent to use data is implied by completion of the questionnaire.

How will I receive feedback?
On project completion, outcomes of the project will be given to all participants via email.

Thank you for taking the time to read this information sheet, and we hope that you will accept our invitation to be involved.

This research project has been approved by the Flinders University Social and Behavioural Research Ethics Committee (Project number: 7863).
For more information regarding ethical approval of the project only, the Executive Officer of the Committee can be contacted by telephone on (08) 8201 3116, by fax on (08) 8201 2035, or by email to human.researchethics@flinders.edu.au

INFORMATION SHEET
(for *parents*)

Title: Investigating teaching strategies for student self-regulated learning

Researcher
Mr Shyam Barr
College of Education, Psychology and Social Work
Flinders University
Tel: 0421 479 959

Supervisors
Associate Professor Helen Askell-Williams
College of Education, Psychology and Social Work
Flinders University
Tel: 08 8201 5671

Professor Janice Orrell
College of Education, Psychology and Social Work
Flinders University
Tel: TBC

Dr. Mirella Wyra
College of Education, Psychology and Social Work
Flinders University
Tel: 08 8201 2392

Description of the study
This study is part of the project titled 'Exploring teachers' knowledge, beliefs and practice about self-regulated learning'. The project will investigate teachers' knowledge, beliefs and teaching practice related to self-regulated learning (SRL). This project is supported by Flinders University, College of Education, Psychology and Social Work.

Purpose of the study
This study aims to investigate how different teaching strategies influence students' SRL.

What will my child be asked to do?
Your child will be invited to complete a short-questionnaire at the beginning of Semester 1 2018, end of Semester 1 2018 and, end of Semester 1 2019. The questionnaire will take approximately 10-15 minutes to complete each time. Questionnaire responses will be used to understand students' SRL.

Additionally, your child may also be invited to complete a 1-page worksheet designed to promote SRL at different times throughout Semester 1, 2018, as part of his/her normal classroom learning activities.

What benefit will my child gain from being involved in this study?
Both questionnaire and worksheets will prompt students to reflect on elements of SRL. Reflection is one method to improving student SRL.

Will my child be identifiable by being involved in this study?
No, any identifying information will be removed, and your child's comments will not be linked directly to him/her. All information and results obtained in this study will be stored in a secure way, with access restricted to the listed researchers.

Are there any risks or discomforts if my child is involved?
No risks or discomforts have been identified.

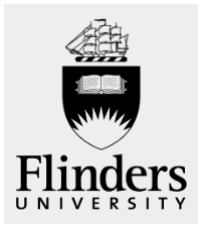
How do I agree to have my child participate?
Participation is voluntary. Your child may answer 'no comment' or refuse to answer any questions, and he/she is free to withdraw from the research components listed above at any time without effect or consequences.

How will I receive feedback?
On project completion, outcomes of the project will be given to all participants via email.

Thank you for taking the time to read this information sheet, and we hope that you will accept our invitation to be involved.

This research project has been approved by the Flinders University Social and Behavioural Research Ethics Committee (Project number: 7863).
For more information regarding ethical approval of the project only, the Executive Officer of the Committee can be contacted by telephone on (08) 8201 3116, by fax on (08) 8201 2035, or by email to human.researchethics@flinders.edu.au

Appendix D. Consent Forms



CONSENT FORM FOR LEAD-TEACHER PARTICIPATION IN RESEARCH

(by questionnaire, interview, think-aloud protocol and lesson observations)

Exploring lead-teachers' knowledge, beliefs and practice about self-regulated learning

I ….....

being over the age of 18 years hereby consent to participate as requested in the letter of introduction and information sheet for the research project on teachers' knowledge, beliefs and practice about self-regulated learning.

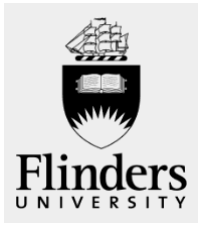
1. I have read the information provided.
2. Details of procedures and any risks have been explained to my satisfaction.
3. I agree to audio/video recording of my information and participation.
4. I am aware that I should retain a copy of the Information Sheet and Consent Form for future reference.
5. I understand that:
   - I may not directly benefit from taking part in this research.
   - I am free to withdraw from the project at any time and am free to decline to answer particular questions.
   - While the information gained in this study will be published as explained, I will not be identified, and individual information will remain confidential.
   - Whether I participate or not, or withdraw after participating, will have no effect on any treatment or service that is being provided to me.
   - I may ask that the recording/observation be stopped at any time, and that I may withdraw at any time from the session or the research without disadvantage.

Participant's signature……Date……..

I certify that I have explained the study to the volunteer and consider that she/he understands what is involved and freely consents to participation.

Researcher's name…….....

Researcher's signature……..Date…….



CONSENT FORM FOR OBSERVATION OF PROFESSIONAL ACTIVITY

Exploring teachers' knowledge, beliefs and practice about self-regulated learning

I hereby give my consent to ……SHYAM BARR…….....

a researcher/research student in the College of Education, Psychology and Social Work at Flinders University whose signature appears below, to record my work activities as part of a study of my professional activities and role.

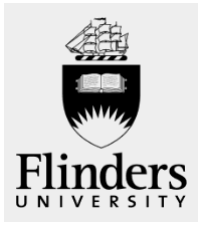
I give permission for the use of these data, and other information which I have agreed may be obtained or requested, in the writing up of the study, subject to the following conditions:

My participation in this study is voluntary, and I understand that I may withdraw from the study at any time.

SIGNATURES

Participant……Date……..

Researcher……Date……



CONSENT FORM FOR STUDENT PARTICIPATION IN RESEARCH

(by student worksheet)

Investigating teaching strategies for student self-regulated learning

I ….....

agree to participate as requested in the letter of introduction and information sheet for the research project on self-regulated learning.

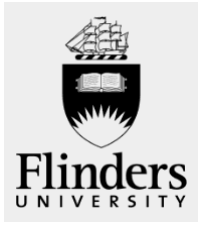
1. I have read the information letter.
2. The project has been clearly explained to me
3. I should keep a copy of the Information Sheet for future reference.
4. I understand that:
   - I may not directly benefit from taking part in this research.
   - I am free to quit from the research at any time
   - I can choose to not answer some or all of the questions
   - My name will not be included in any reports
5. I have had the opportunity to discuss taking part in this research with a parent/carer, family member or friend.

Participant's signature……Date……...

I certify that I have explained the study to the volunteer and consider that she/he understands what is involved and freely consents to participation.

Researcher's name…….....

Researcher's signature……..Date……



PARENTAL CONSENT FORM FOR CHILD PARTICIPATION IN RESEARCH

(by questionnaire and/or student worksheet)

Investigating teaching strategies for student self-regulated learning

I ….....

being over the age of 18 years hereby consent to my child .....

participating, as requested in the letter of introduction and information sheet for the research project on self-regulated learning.

1. I have read the information provided.
2. Details of procedures and any risks have been explained to my satisfaction.
3. I am aware that I should retain a copy of the Information Sheet and Consent Form for future reference.
4. I understand that:
   - My child may not directly benefit from taking part in this research.
   - My child is free to withdraw from the project at any time and is free to decline to answer particular questions.
   - While the information gained in this study will be published as explained, my child will not be identified, and individual information will remain confidential.
   - Whether my child participates or not, or withdraws after participating, will have no effect on any treatment or service that is being provided to him/her.
   - Whether my child participates or not, or withdraws after participating, will have no effect on his/her progress in his/her course of study, or results gained.

Participant's signature……Date……..

I certify that I have explained the study to the volunteer and consider that she/he understands what is involved and freely consents to participation.

Researcher's name…….....

Researcher's signature……..Date…….

Appendix E. Email Text

Email Text to recruit / contact – for **PARENTS of students within school middle-leaders' classes**

Dear Parents,

My name is Shyam Barr and I am undertaking a Doctor of Philosophy at Flinders University. As part of my studies I am investigating students' self-regulated learning.

Please find attached a letter of introduction and information sheet with further details regarding my study.

I will ask you to help me with my research by indicating your consent for your child's participation in this study via the link below. Your child will be invited to complete a one-page worksheet at three different times during Semester 1, 2018. The worksheet is designed to prompt and measure student engagement in self-regulated learning and will be completed as your child engages in a regular learning activity in their {insert subject} class.

(Insert link to Consent form in Microsoft Forms)

Later, I will write a report about my research and give it to the appropriate university examiners to mark.

If any publications arise from my research, no individuals or sites will be named, nor recognisable.

All participation is voluntary and confidential.

Thank you in advance,

Shyam Barr

Email Text to recruit / contact – for **regular classroom teachers**

Dear Teachers,

My name is Shyam Barr and I am undertaking a Doctor of Philosophy at Flinders University. As part of my studies I am investigating teachers' knowledge, beliefs and practice about self-regulated learning. Your school has expressed interest in participating.

Please find attached a letter of introduction and information sheet with further details regarding my study.

I will ask you to help me with my research by completing a short survey at three different time points over the course of this year and the next. The survey should take about 10-15 minutes to complete each time.

The below link provides you access to the survey. It is entirely up to you whether you choose to participate in my research project. By completing the survey, you will be allowing me to use your data/results as part of my investigation.

(Insert survey link)

Later, I will write a report about my research and give it to the appropriate university examiners to mark.

If any publications arise from my research, no individuals or sites will be named, nor recognisable.

All participation is voluntary and confidential and you are able to withdraw from participating at any time.

Thank you in advance,

Shyam Barr

Email Text to recruit / contact – for **PARENTS of students within regular classroom teachers' classes**

Dear Parents,

My name is Shyam Barr and I am undertaking a Doctor of Philosophy at Flinders University. As part of my studies I am investigating students' self-regulated learning.

Please find attached a letter of introduction and information sheet with further details regarding my study.

I will ask you to help me with my research by indicating your consent for your child's participation in this study via the link below. Your child will be invited to complete a short survey at three different times over the course of this year and Semester 1, 2019. Each survey should take about 10-15 minutes to complete.

(Insert link to Consent form in Microsoft Forms)

Later, I will write a report about my research and give it to the appropriate university examiners to mark.

If any publications arise from my research, no individuals or sites will be named, nor recognisable. All participation is voluntary and confidential.

Thank you in advance,

Shyam Barr

Email Text to recruit / contact – for **students within regular classroom teachers' classes**

Dear Students,

My name is Shyam Barr and I am undertaking a Doctor of Philosophy at Flinders University. As part of my studies I am investigating students' self-regulated learning.

Please find attached a letter of introduction and information sheet with further details regarding my study.

I will ask you to help me with my research by completing a short survey at three different time points over the course of this year and Semester 1, 2019. Each survey should take about 10-15 minutes to complete.

The below link provides you access to the survey. It is entirely up to you whether you choose to participate in my research project. By completing the survey, you will be allowing me to use your data/results as part of my investigation.

(Insert survey link)

Later, I will write a report about my research and give it to the appropriate university examiners to mark.

If any publications arise from my research, no individuals or sites will be named, nor recognisable.

All participation is voluntary and confidential.

Thank you in advance,

Shyam Barr

Appendix F. Permission Request Letter

PERMISSION REQUEST
(by email to School)

Dear {Principal or delegate of School}

Shyam Barr is currently a Doctor of Philosophy student in the College of Education, Psychology and Social Work at Flinders University. He can produce his student card, which carries a photograph, as proof of identity should you require.

Shyam is undertaking research leading to the production of a thesis or other publications on the subject of teaching and learning.

I would like to request your permission for Shyam to approach the {school middle-leaders}, teachers and students, and upon their consent conduct the following study at {insert school name} during the 2018 and 2019 school years.

School middle-leaders

The study will consist of six 2-hour professional development sessions over a period of twelve weeks (one session per fortnight) related to a self-regulated learning (SRL) teaching approach. These sessions will be incorporated into the {school middle-leaders} regular professional development program. The six sessions will include group discussions where {school middle-leaders} will reflect on their experiences of the weekly trialled in-class SRL teaching approach, engage with new knowledge and record their thinking-aloud while engaged in lesson planning. {school middle-leaders} will also be asked to contribute suggestions for improvement to the SRL teaching approach for delivery in lessons over the following weeks. In between each professional development session, each {school middle-leader} will be required to implement the SRL teaching approach with their respective classes. During the professional development period, Shyam will conduct three video-recorded lesson observations as a method to provide {school middle-leaders} with feedback related to the implementation of the SRL teaching approach.

In addition, at the beginning of Semester 1 2018, the end of Semester 1 2018, and the end of Semester 1 2019, each {school middle-leader} will complete a questionnaire (approximately 30 minutes), participate in a 45 minute audio-recorded individual interview, and allow Shyam to video-record three lessons for each {school middle-leader} as a method to gather information about their teaching practice about SRL. The questionnaires and interviews will explore {school middle-leaders'} knowledge, beliefs and practice about SRL, and their experience of the SRL

teaching approach in their classrooms. Shyam will take notes of all responses during all sessions. The lesson observations will measure teaching practice about SRL. No more than two hours on any one occasion would be required.

Teachers and students

Teachers and students will be invited to complete a questionnaire (approximately 15 minutes) at the beginning of Semester 1 2018, the end of Semester 1 2018, and the end of Semester 1 2019. The teacher questionnaire explores teachers' knowledge, beliefs and practice about explicit teaching of SRL. The student questionnaire will measure students' knowledge and beliefs about SRL.

Shyam intends to document the completed questionnaires, interview responses, think alouds and video-recorded lessons for preparation of his thesis on the condition that no names or identities are revealed. He will seek formal consent from each of the participants. Be assured that any information provided will be treated in the strictest confidence and none of the participants will be individually identifiable in the resulting report or other publications.

Lastly, at the end of this research project, I will provide you with an executive summary outlining key findings and recommendations related to the explicit teaching of SRL.

Any enquiries you may have concerning this project should be directed to Shyam by telephone 0421 479 959 or by email shyam.barr@flinders.edu.au; or to me at the above address.

I ask that you kindly respond to this email indicating your permission and support of this study.

Thank you for your attention and assistance.

Yours sincerely

Helen Askell-Williams

Director, Flinders Educational Futures Research Institute

College of Education, Psychology and Social Work

Appendix G. Ethics Approval

The following segment is taken from an email indicating ethics approval received from the Social and Behavioural Research Ethics Committee (SBREC) on 20 December 2017.

FINAL APPROVAL NOTICE

Project No.:	**7863**
Project Title:	Transforming lead-teachers' epistemic cognition about explicit teaching of self-regulated learning: A step closer to sustained implementation?
Principal Researcher:	Mr Shyam Barr
Email:	shyam.barr@flinders.edu.au
Approval Date:	20 December 2017
Ethics Approval Expiry Date:	**20 March 2021**

Appendix H. Process for Teacher/Student Lucky Number Draw

The process for teacher/student lucky number draws was:

1. Teacher/Student Identification numbers (provided as part of survey completion) were used as ‘Lucky Numbers’ and were exported from the ACSPRI survey platform into an excel spreadsheet.
2. A random value (i.e. Lucky Number) was generated from the list in Excel (using the Excel Index function).
3. The Lucky Number and gift voucher were provided to the nominated Professional Support Staff member in the School’s Teacher/Student services section.
4. The holder of the winning Lucky Number was notified by the Professional Support Staff and collected their voucher from Teacher/Student services at school.
5. Gift vouchers not collected within one month of notification were given to the school.

Appendix I. Teachers' Epistemic Cognition about SRL Questionnaire

Knowledge and Beliefs about Self-Regulated Learning

The Knowledge and Beliefs about Self-Regulated Learning questionnaire for Teachers is designed to gather information about factors (e.g. knowledge, beliefs) that influence teachers' decision-making processes related to promoting self-regulated learning (SRL) in the classroom.

It will take approximately 20-30 minutes to complete.

Prior knowledge about SRL

1. According to you: What is Self-Regulated Learning (SRL)? Please provide as much detail as possible.

2. What are the "types" of things your students need to know to self-regulate their learning well?

3. What knowledge is necessary for effective teaching about SRL? Please be specific. (Open)

Beliefs about SRL

	Very untrue	Untrue	Somewhat untrue	Neutral	Somewhat true	True	Very True
4. Knowledge of how to self-regulate learning comes from the teacher	O	O	O	O	O	O	O
5. Knowledge of how to self-regulate learning comes from a student's own personal construction	O	O	O	O	O	O	O
6. SRL is a talent students are born with	O	O	O	O	O	O	O
7. Students can learn how to be effective self-regulated learners	O	O	O	O	O	O	O
8. Knowledge of SRL is equal in complexity to other subjects (e.g. maths)	O	O	O	O	O	O	O

Teaching goals about SRL

	Very untrue	Untrue	Somewhat untrue	Neutral	Somewhat true	True	Very True
9. When planning a regular lesson, I explicitly set a teaching goal to develop students' knowledge about SRL	O	O	O	O	O	O	O
10. It is important to develop students' knowledge about SRL	O	O	O	O	O	O	O
11. When planning a regular lesson, I explicitly set a teaching goal to assess students' knowledge about SRL	O	O	O	O	O	O	O
12. It is important to assess students' knowledge about SRL	O	O	O	O	O	O	O

For the following two items, please indicate percentage of **total number of lessons taught**

	0-15%	16-30%	31-45%	46-60%	61-75%	76-90%	>90%
13. In the past week, how many lessons have you explicitly set a teaching goal to develop students' knowledge about SRL?	O	O	O	O	O	O	O
14. In the past week, how many lessons have you explicitly set a teaching goal to assess students' knowledge about SRL	O	O	O	O	O	O	O

Assessment of SRL

	Very untrue	Untrue	Somewhat untrue	Neutral	Somewhat true	True	Very True
15. I know when students have achieved deeper knowledge about SRL	O	O	O	O	O	O	O

16. How do you know if students have achieved deeper knowledge about SRL?

	Very untrue	Untrue	Somewhat untrue	Neutral	Somewhat true	True	Very True
17. I use a set of criteria to evaluate whether students have achieved deeper knowledge about SRL	O	O	O	O	O	O	O

18. If so, what criteria do you use?

Teacher metacognition

	Very untrue	Untrue	Somewhat untrue	Neutral	Somewhat true	True	Very True
19. I pace myself while I am teaching about SRL in order to have enough time.	O	O	O	O	O	O	O
20. I ask myself periodically if I meet my teaching goals about SRL while I am teaching.	O	O	O	O	O	O	O
21. I ask myself how well I have accomplished my teaching goals about SRL once I am finished	O	O	O	O	O	O	O
22. I set my specific teaching goals about SRL before I start teaching	O	O	O	O	O	O	O
23. I find myself assessing how useful my teaching techniques for SRL are while I am teaching.	O	O	O	O	O	O	O
24. I ask myself if I could have used different SRL techniques after each teaching experience.	O	O	O	O	O	O	O
25. I ask myself questions about SRL teaching materials I am going to use.	O	O	O	O	O	O	O
26. I check regularly to what extent my students comprehend the topic of SRL while I am teaching.	O	O	O	O	O	O	O
27. After teaching a point about SRL. I ask myself if I'd teach it more effectively next time.	O	O	O	O	O	O	O
28. I organize my time to best accomplish my teaching goals about SRL.	O	O	O	O	O	O	O
29. I ask myself questions about how well I am doing while I am teaching about SRL.	O	O	O	O	O	O	O
30. I ask myself if I have considered all possible SRL techniques after teaching a point.	O	O	O	O	O	O	O

31. What is the best way to teach students SRL? Why?

For the following two items, please indicate percentage of total number of lessons taught

	0-15%	16-30%	31-45%	46-60%	61-75%	76-90%	>90%
32. In the past week, how many lessons have you taught students' SRL in this way	O	O	O	O	O	O	O

Explicitly teaching students about SRL strategies can improve student SRL knowledge

	0-15%	16-30%	31-45%	46-60%	61-75%	76-90%	>90%
33. In the past week, how many lessons have you taught students' SRL in this way	O	O	O	O	O	O	O

34. What is the best way to assess students' SRL? Why?

For the following two items, please indicate percentage of total number of lessons taught

	0-15%	16-30%	31-45%	46-60%	61-75%	76-90%	>90%
35. In the past week, how many lessons have you assessed students' SRL in this way	O	O	O	O	O	O	O

Metacognitive prompts (e.g. what is your goal for this task?) can engage students in SRL and provide valuable feedback on how students are self-regulating their learning.

	0-15%	16-30%	31-45%	46-60%	61-75%	76-90%	>90%
36. In the past week, how many lessons have you incorporated	O	O	O	O	O	O	O

metacognitive prompts in your teaching?

Perceptions of enablers and barriers to implementation of SRL teaching initiatives	Very untrue	Untrue	Somewhat untrue	Neutral	Somewhat true	True	Very True
37. Leadership staff in my school support explicit teaching of SRL	O	O	O	O	O	O	O
38. I have undertaken useful professional development about SRL	O	O	O	O	O	O	O
39. Many staff in my school have undertaken useful professional development about SRL	O	O	O	O	O	O	O
40. My school regularly reports to staff our progress with developing students' SRL	O	O	O	O	O	O	O
41. Promoting students' SRL is included in our school mission statements	O	O	O	O	O	O	O
42. Our parent community supports us teaching about SRL	O	O	O	O	O	O	O
43. In my school, developing students' knowledge about SRL forms part of the curriculum	O	O	O	O	O	O	O
44. If the key staff who promote SRL were to leave our school the emphasis on it would probably die out	O	O	O	O	O	O	O
45. In truth, SRL is a current fad, that will eventually be replaced by the next 'big thing'	O	O	O	O	O	O	O

46. What is the most important factor for sustained implementation of explicit teaching of SRL? Please explain.

47. What is the most significant barrier to sustaining explicit teaching of SRL? Please explain.

Demographics

Staff I.D. Number (This is located on your Staff I.D. card and is only used to match pre- and post- results to the same participant. This information will	(Open)

not be used to identify you as a participant).	
Role in school	○ Year Level Coordinator (Year 7 Coordinator) ○ Subject Coordinator/Head of Faculty (e.g. Science Coordinator) ○ Executive/Senior Leadership Team (e.g. Head of Teaching and Learning, Director of Senior Years Program) ○ Principal class
Gender	(Open)
Age	○ Under 25 ○ 25-29 ○ 30-39 ○ 40-49 ○ 50+
What subjects do you teach?	○ English ○ Maths ○ Science ○ Language Other Than English (LOTE) ○ History ○ Geography ○ Visual Arts ○ Drama ○ Music ○ Business studies
Highest degree achieved	○ Bachelor's degree ○ Master's degree ○ Doctorate
How many years have you been teaching for?	○ 1-2 years ○ 3-5 years ○ 6-10 years ○ 11+ years
In the past 5 years, have you participated in professional development in any of the following areas?	○ Self-Regulated Learning ○ Cognitive Psychology ○ Learning Strategies ○ Metacognition ○ Special Education/Special Needs

	○ I have had no professional development in any of these fields or similar

Appendix J. Lesson Plan Template (Before and After PLC-ER)

The following is the lesson plan template used for data collection before, immediately after, and again 9-months after the conclusion of the school middle-leaders' PLC-ER about SRL.

Learning outcomes:
Planned teaching and learning activities:

Appendix K. Lesson Plan Template (During PLC-ER)

The following is the lesson plan template used for data collection during the school middle-leaders' PLC-ER about SRL.

Learning outcomes:

1. Make sure you include at least one learning outcome (i.e. knowledge aim) for student SRL
   (Consider where this knowledge comes from, whether it is simple or complex and how you will know if a student has achieved this learning outcome)

Planned teaching and learning activities:

2. Plan teaching and learning activities to achieve the learning outcomes set for SRL

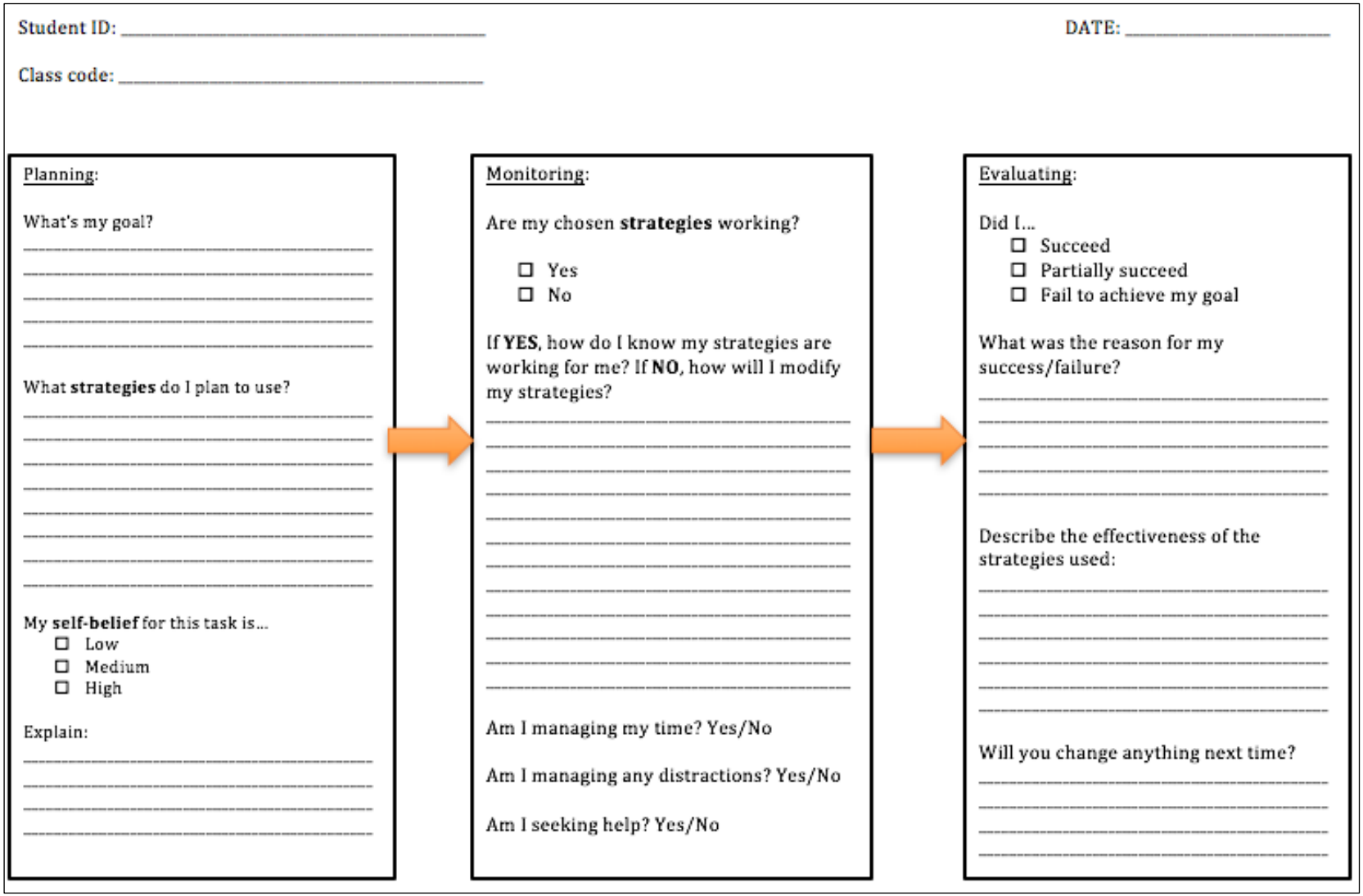
After planning your lesson:

3. Consider the reasons for your choice of teaching and learning activities – will they effectively achieve the learning outcome? If not, do you need to make some changes?

4. After planning your lesson, reflect on whether the planned teaching and learning activities align with:
   a. School priorities/policies?
   b. Curriculum expectations?
   c. Your own values and motivations?
   d. Other perspectives? (e.g. AITSL, current research, parents, future of education)

   What does the setting learning outcomes and planning learning activities for SRL mean for you?

Appendix L. SRL Process Protocols



Appendix M. Outline of Professional Education Sessions

Session	Learning outcomes	Starter	Main	Plenary	Initial resources/Notes
1.	**Title: How do we define SRL?** 1. What is a Professional Learning Community? ~ 2. Setting norms/expectations for the Professional Learning Community, 3. Developing a shared definition for SRL 4. Instructions for how to implement the student SRL Process Protocols 5. Recording thinking-aloud while planning a lesson to promote SRL	Introduced notion of a PLC and discussed norms and expectations. Group generated a list of agreed norms and expectations that included the following: - Give attention to whoever is speaking - Do not interrupt the person speaking - Maintain a respectful environment - No consensus required - All stakeholders involved - Equal participation - No judgement - Come prepared - Be on time - Respectful use of technology - Refreshments to be provided	Introduced brainstorm question: What is SRL? Using the Generate, Sort, Connect, Elaborate activity (Ritchhart, Church, & Morrison, 2011), school middle-leaders activated and shared their prior knowledge about SRL, and collaboratively discussed similarities and differences, attempting to arrive at a shared definition. Additionally, Zimmerman's triadic model of SRL was discussed as a popular SRL framework. The SRL Process Protocols (a Process Protocols framed on Zimmerman's triadic model) was shared, accompanied by instructions for how to implement the SRL Process Protocols in classroom.	Group discussed possible teaching actions School middle-leader participants recorded their thinking-aloud while engaged in *regular and reflexive* lesson planning	Text: Cognitive Psychology and Instruction (Bruning, Schraw, & Norby, 2011) Key articles: Becoming a Self-Regulated Learner - An overview (Zimmerman, 2002), Self-regulation of learning- Process approaches to personal development (Zimmerman & Labuhn, 2012)
2.	**Title: How do we assess SRL?**	Activated prior knowledge/goals/outcomes expectations – What do you already know about promoting SRL? (Explicitly prompted different pedagogical strategies for promoting student SRL) What questions do you have about SRL and teaching SRL? (Explicitly prompted and model different question generating strategies)	Brainstormed and discussed focus question: 'How do we currently promote SRL in the classroom?' Collated questions: - How do you assess SRL? - How many SRL strategies should you teach/model in one lesson? - What are the different SRL strategies? - Is SRL more effective in a student led model? - How explicit does SRL have to be? - Do you have to model SRL in class to teach it? - Is there a difference between writing/reading strategies to SRL strategies? - Are students more open to SRL strategies in groups? - What is the biggest road block to SRL? - What does the research say about adolescent brains and SRL?	Group discussed possible teaching actions School middle-leader participants recorded their thinking-aloud while engaged in *reflexive* lesson planning	Motivated Strategies for Learning Questionnaire (Pintrich, Smith, et al., 1993) Metacognitive Awareness Inventory (Schraw & Dennison, 1994)

3.	**Title: What are SRL strategies?**	Facilitator showed a short video recapping SRL. Link: https://www.youtube.com/watch?v=aHbFfgk6dfg	School middle-leaders engaged with Chapter 5: Self-Regulation Strategies by Reid et al. (2013) School middle-leaders grouped each of the previously generated strategies and newly constructed strategy knowledge under the following headings: **Metacognitive strategies:** Planning strategies, Monitoring strategies**,** Evaluating strategies **Other strategies:** Motivation strategies, Cognitive/Learning strategies**,** Use of time**,** Physical and Social Environment**,** Subject/Task strategies**,** Uncategorised School middle-leaders engaged with Chapter 6: Implementing Self-Regulation strategies by Reid et al. (2013)	Group discussed possible teaching actions School middle-leader participants recorded their thinking-aloud while engaged in *reflexive* lesson planning	Texts: Cognitive Psychology and Instruction (Bruning et al., 2011) (Reid et al., 2013)
4.	**Title: What is explicit instruction of SRL strategies?** How might strategy instruction foster self-regulated learning? • What is strategy instruction? • How does strategy instruction function? How might we set up a classroom that promotes SRL?		1. Short training in modified observation protocol 2. Teachers watch a short video of a lesson and complete modified observation protocol Discuss.	Group discussed possible teaching actions School middle-leader participants recorded their thinking-aloud while engaged in *reflexive* lesson planning	(Brown et al., 1981) ATES observation manual (Dignath-van Ewijk et al., 2013)
5.	**Title: Debrief** •	Revisited collated questions identified in the second professional development session. Identified which questions had been answered during the professional development program and what questions still required further investigation.	Completed a self-evaluation and future goal-setting exercise that included the following questions/prompts: **Title: How might we improve SRL at [school name] better than we already do?** 1. Which of the following PLC sessions did you attend (please circle): (1) What is SRL? (2) How do we assess SRL? (3) SRL strategies (4) Explicit instruction of SRL (5) Debrief 2. The third professional development session 'SRL strategies' included critical content. Have you engaged all the	Nil	Texts: Cognitive Psychology and Instruction (Bruning et al., 2011)

			content available on the intranet as part of session 3? Yes or No 3. Circle which observation and feedback cycles you engaged in: 1, 2, 3, 4		

Appendix N. Think-aloud Protocol

What is a Think-Aloud?

A Think-Aloud involves an individual verbalising their thoughts as they engage in an activity. A Think-Aloud serves a dual purpose:

1. to enhance self-awareness of thinking processes related to an activity
2. to capture real-time data about thinking processes
3.

For this professional learning project, you are asked to think-aloud as you engage in lesson planning. This might include saying what you are thinking, doing, and/or feeling.

How will you record each Think-Aloud?

- Voice recording app on laptop/phone

Practice

Choose an upcoming lesson that requires planning for a class that is NOT your focus class. Using the lesson plan template, complete the following:

1. Begin voice recorder
2. Begin thinking-aloud as you plan the lesson
3. Once completed, switch off voice recorder
4. Listen to your think-aloud to ensure it has recorded correctly

Recording a Think-Aloud

Choose an upcoming lesson that requires planning for your focus class. Using the lesson plan template, complete the following:

1. Begin voice recorder
2. Begin thinking-aloud as you plan the lesson
3. Once completed, switch off voice recorder
4. Listen to your think-aloud to ensure it has recorded correctly

Share with a USB/Email audio file to researcher

Appendix O. Coding Manual

CONTENTS OF THIS CODING MANUAL

This coding manual is separated by different tables. Each table represents a key theoretical construct or a group of related theoretical constructs.

Table A.1 is an example of how participant responses were parsed into text segments and coded.

Table A.1: Example of how a participant response was parsed into text segments representing individual meaning

Table A.2 through 4 were used to code the open-ended responses to the TEC-SRL questionnaire.

Table A.2: Codes related to the Teachers' knowledge and beliefs - Prior Knowledge

Table A.3: Codes related to the Teachers' knowledge and beliefs – Epistemic stances/Ideals, Epistemic Virtues/Vices and Epistemic Value

Table A.4: Codes related to the Teachers' knowledge and beliefs – Perception of factors related to the sustained implementation of explicit teaching of SRL strategies

Table A.5 was used (in addition to Tables A.2-A.4) to code the think-aloud transcripts

Table A.5: Process codes related to teachers' epistemic cognition about SRL

Coding procedure

1. Parse text into individual text segments based on a single ‘unit of meaning’. Text segments can be short phrases (2-3 words; e.g. ‘setting goals’), sentences (e.g. ‘where students have the capacity to examine their own learning and identify ways to improve’) or complete paragraphs.

2. Code each parsed text segment using the coding framework described in this coding manual. Start by coding the text segment to a **Coding Category 1 code,** then if possible, add extension codes from **Coding Categories 2 and 3**. If more than one code is appropriate, then use multiple codes for the text segments.

Table A.1. Example of participant response parsed into text segments

Original response	Response parsed into text segments	Codes allocated
SRL is the process of thinking about your thinking, planning and setting goals, trying to achieve the goals and then reflecting on the process and whether you have achieved the goal. It's a kind of cycle. [It is] How students regulate their own behaviour, emotions and learning experiences.	SRL is the process of thinking about your thinking,	CK-G-Met
	planning and setting goals,	CK-F-Tas
	trying to achieve the goals	CK-P-Con
	and then reflecting on the process and whether you have achieved the goal.	CK-S-Jud
	It's a kind of cycle.	CK-G-Pro
	[It is] How students regulate their own behaviour, emotions and learning experiences	CK-G-Nil

Staged coding procedure

CODING OF TEC-SRL OPEN-ENDED QUESTION RESPONSES

Stage 1:

Using *Table A.2*, code the LT Knowledge spreadsheet (4 open-ended questions taken from the TEC-SRL questionnaire).

Stage 2:

Using *Table A.2 with the addition of the EI code from Table A.3*, code the LT Epistemic Stance/Ideals spreadsheet (1 open-ended question taken from the TEC-SRL questionnaire). Note: Any text segment (i.e. the majority in this section) that indicates any form of criteria the teacher would use to evaluate student SRL capabilities should be coded to EI, with the addition of a 'PCK-A-…' code.

Stage 3:

Using *Table A.4*, code the LT Enablers and Barriers (2 open-ended questions taken from the TEC-SRL questionnaire)

CODING OF THINK-ALOUD TRANSCRIPTS

Stage 4

Using Table A.2, Table A.3 and Table A.5, code the think-aloud transcripts.

Table A.2. Codes related to knowledge about teaching

Coding category 1	Coding category 2	Coding category 3	Description and Justification (Evidence from literature)	Example text segments
Content Knowledge (CK) about SRL	Metacognitive learning strategies: Forethought CK-F	Task Analysis: CK-F-Tas	Text segments related to task analysis, such as goal-setting and strategic planning "Planning activities that have been investigated in various studies of students' learning include setting goals for studying, [identifying and selecting task strategies such as] skimming a text before reading, generating questions before reading a text, and doing a task analysis of the problem. These activities seem to help the learner plan their use of cognitive strategies and also seem to activate or prime relevant aspects of prior knowledge, making the organization and comprehension of the material much easier." (Pintrich, 1999, p. 461) According to Pintrich (1999, p. 461) "planning is essentially the task analysis, goal setting, strategic planning etc." "Organizing and transforming - Statements indicating student-initiated overt or covert rearrangement of instructional materials to improve learning, e.g., "I make an outline before I write my paper."" (Zimmerman, 2013, p. 138)	"setting goals" "how to set effective goals" "planning and setting goals" "how to plan, goal setting" "So what I haven't done before which I want to try to do today is have the girls really think about what they want to achieve in this lesson so to set a goal and then use this routine [e.g. beep strategy/self-recording activity] to help them achieve that goal"
		Self-Motivation beliefs CK-F-Mot	Text segments indicating teacher knowledge related to self-efficacy, outcome expectations, intrinsic interest/value, learning goal orientation (Zimmerman, 2002) "Because task analysis, goal setting, and strategic planning require personal initiative and persistence, they require high levels of key self-motivation beliefs/values. Proactive learners are motivated by higher self-efficacy beliefs, outcome expectancies, mastery learning goals, and/or task interest/ valuing. By contrast, reactive learners display inferior forms of motivation and as a result are less self-motivated to analyze tasks, select goals, or plan strategically than proactive learners." (Zimmerman, 2013, p. 143)	"a positive growth mindset, self-efficacy" "[They need to know] their own motivations"
	Metacognitive learning strategies: Performance CK-P	Self-Control CK-P-Con	"Self-control refers to the use of specific techniques to direct learning, such as self-instruction, imagery, attention focusing, task strategies, environmental structuring, and help seeking. During this phase, proactive learners perform self-control processes that were planned during the	"trying to achieve the goals" "dealing with distraction" [i.e. attention focusing]

			forethought phase, such as using an outline to produce text of a story" (Zimmerman, 2002) Imagery, Self-instruction, Attention focusing, task strategies	
		Self-observation CK-P-Obs	Metacognitive monitoring and Self-recording (Zimmerman, 2002) "Metacognitive monitoring refers to informal mental tracking of one's performance processes and outcomes, whereas self-recording refers to creating formal records of learning processes and/or outcomes, such as a graph of one's generation of text regarding each section of an outline. Self-recording can enhance self-control because it increases the reliability, specificity, and timeliness of self- observations. By contrast, reactive learners find it difficult to self-observe a particular process, such as essay completion, because they lack specific forethought phase goals or plans to focus their attention" (Zimmerman, 2002) "Monitoring activities include tracking of attention while reading a text or listening to a lecture, self-testing through the use of questions about the text material to check for understanding, monitoring comprehension of a lecture, and using test-taking strategies (i.e., monitoring speed and adjusting to time available) in an examination situation. These various monitoring strategies alert the learner to breakdowns in attention or comprehension that can then be "repaired" using regulation strategies."(Pintrich, 1999, p. 461)	"plan how they can achieve their goal, monitor and reflect on their learning strategies" "So what I'm hoping for is using the beep strategy today [i.e. self-recording activity] will help the girls to maintain their focus during that time"
	Metacognitive learning strategies: Self-Reflection CK-S	Self-judgement CK-S-Jud	A statement related to student self-reflection that includes a specific reference to an evaluation of learning, their attributions for success/failture and identifying opportunities for improvement "Statements indicating student-initiated evaluations of the quality or progress of their work, e.g., "I check over my work to make sure I did it correct.""(Zimmerman, 2013, p. 138)	"reflect on their learning strategies to maximise their learning goals, and evaluate how effectively these strategies have worked" "where students have the capacity to examine their own learning and identify ways to improve" "[students need to know] how to evaluate [their learning] – formally and informally"
		Self-reaction CK-S-Rea	Self-satisfaction/affect, Adaptive/defensive reaction (Zimmerman, 2002) "Learners' self-judgments are linked to two key forms of self-reactions: self-satisfaction and adaptive inferences. Self-satisfaction reactions refer to perceptions of satisfaction or dissatisfaction (and associated affect) regarding one's performance. These emotions can range from elation to	No text segments coded to this category

			depression. It is hypothesized that proactive students will pursue courses of action that result in satisfaction and positive affect and will avoid courses that produce dissatisfaction and negative affect. Reactive learners' attribution of errors to uncontrollable causes leads them to feel dissatisfied, which in turn discourages them from further efforts to learn. By contrast, proactive learners' attribution of errors to controllable causes leads them to feel satisfied, which in turn sustains their efforts to learn. A closely associated form of self-reactions involves adaptive or defensive inferences, which refer to conclusions about whether one needs to alter his or her approach during subsequent efforts to learn. Because of their favorable attributions and high level of self-satisfaction, proactive students are expected to make adaptive inferences for s, such as by modifying a strategy for solving a math problem. Because of their unfavorable attributions and low level of satisfaction, reactive students resort to defensive inferences to protect themselves from future dissatisfaction and aversive affect, such as helplessness, procrastination, task avoidance, cognitive disengagement, and apathy." (Zimmerman, 2013, pp. 143-144)	
	Cognitive learning strategies CK-C	Rehearsal strategies CK-C-Reh	"Rehearsal strategies involve the recitation of items to be learned or the saying of words aloud as one reads a piece of text. Highlighting or underlining text in a rather passive and unreflective manner also can be more like a rehearsal strategy than an elaborative strategy." (Pintrich, 1999)(p. 460)	No text segments coded to this category
		Elaboration strategies CK-C-Ela	Elaboration – "paraphrasing, summarizing the material, creating analogies, generative note-taking [where the student actually reorganizes and connects ideas in their notes in contrast to passive, linear note-taking], explaining the ideas in the material to be learned to someone else, and question asking and answering" (Weinstein & Mayer, 1986, as cited in Pintrich (1999, p 460) "Elaborative rehearsal is any form of rehearsal [strategy] in which the to-be-learned information is related to other information (Lockhart, 2002)" (as cited in Bruning et al., 2011, p. 67) Examples of elaborative rehearsal strategies include Mediation, Imagery, Mnemonics (e.g. The Peg Method), Method of Loci, The Link Method, Stories, The First-Letter Method, The Keyword Method)	No text segments coded to this category
	Resource Management strategies	-	"[Resource Management are] strategies that students use to manage and control their environment. Examples include managing and controlling their time, their effort, their study	"[Students need to know] how to organize their time properly"

	CK-Res		environment, and other people, including teachers and peers, through the use of help-seeking strategies (cf., Corno, 1986; Ryan & Pintrich, 1998; Zimmerman & Martinez-Pons, 1986,1988).(as cited in Pintrich, 1999, p. 462)	
	General statement about SRL or conditions for SRL CK-G	Process CK-G-Pro	A general statement about SRL that includes process of planning, monitoring and evaluating (or similar). Basically, three words divided by commas that represent the three phases with no additional information. (If additional information is provided code as separate phases) Also, any reference to 'cycle' or 'cyclic process'.	"Self-regulation strategies can fall into three sections - planning, monitoring and evaluating"
		Metacognition CK-G-Met	This is an inductive code that emerged from the first and second cycles of coding. A general statement that includes a specific reference to metacognition or being 'metacognitively aware' or similar (e.g. conscious, awareness)	"Learning directed by meta-cognitive practices" "SRL is the process of thinking about your thinking,"
		Learning Strategies CK-G-Str	This is an inductive code that emerged from the first and second cycles of coding. A general statement that includes a specific reference to strategies, learning strategies or tools	
		Autonomy CK-G-Aut	This is an inductive code that emerged from the first and second cycles of coding. SRL only occurs in autonomous environment (Independent choice)	"Learners can self regulate at any point where they have an opportunity to choose independently." "They also need conditions to self-regulate - less teacher input as in the classic teacher led instructional model"
		No specific SRL element described CK-G-Nil	This is an inductive code that emerged from the first and second cycles of coding. A general statement about SRL with no specific reference to any of the above listed elements	"[SRL is when] They [i.e. students] think about the process of learning and how they can be a better learner"
Pedagogical Content Knowledge about SRL PCK	Strategy Instruction PCK-L *This is related to the development of student SRL knowledge*	Explicit PCK-L-Exp	"in explicit strategy teaching the teacher directly advises students to use a certain strategy or even gives concrete information how and in which situations to apply the strategy" (Kistner et al., 2015, p. 177) Any text segment that indicates teachers' pedagogical content knowledge related to the explicit teaching/prompting of SRL strategies	"explicit teaching to introduce [SRL] process and various strategies" "teacher modeling - explain what and why you are doing things" "Students need to be explicitly taught strategies and then be given opportunities to put them into practice"
		Implicit PCK-L-Imp	"Implicit strategy teaching covers teacher utterances or behaviors that are supposed to enhance the use of a learning strategy in students, but that do neither involve informing students about a strategy nor advising them directly to use it. For example, the	"Small activities that engage students in reflection about their learning."

			teacher models the use of a strategy or prompts students to use a strategy by asking questions."(Kistner et al., 2015, p. 177) Any text segment that indicates teachers' pedagogical content knowledge related to the implicit teaching/prompting of SRL strategies	
		General pedagogical statement for promoting SRL PCK-L-Gen	A general statement about the pedagogical strategies to foster SRL that do not fit with either of the above PCK categories. This is for miscellaneous statements related to promoting/fostering SRL.	"Transparency about SRL within the curriculum"
	Assessment PCK-A *This is related to the teacher's assessment of student SRL knowledge*	Teacher refers to observation of student behaviour (including contributions to discussion) PCK-A-Obs	This is an inductive code that emerged from the first and second cycles of coding. Teachers made a number of statements that referred to teacher observation of student behaviour as a pedagogical strategy for assessing students' knowledge about SRL.	[Best way to assess student SRL is through…] "observation/interviews" "Depends on what SRL strategy you are assessing. If time management, assess whether they can successfully meet outcomes within a certain time limit."
		Teacher uses a formal evaluation sheet for SRL or similar (e.g. log book, reflection sheet, survey) PCK-A-Eva	Learning protocols (Berthold et al., 2007; Gutierrez & Schraw, 2015)	[Best way to assess student SRL is through…] "tools such as surveys that provide feedback to the teacher" "Depends on what SRL strategy you are assessing… If about self efficacy, survey them on their self belief for certain skill etc." "reflections on how they have used their time and how effective they were in achieving their goals"
		General pedagogical statement for assessing SRL PCK-A-Gen	A general statement about the pedagogical strategies to assess SRL that do not fit with either of the above PCK categories. This is for miscellaneous statements related to assessing SRL.	"Improved performance in assessment tasks, especially open ended tasks"

Note: The code '**NIL**' was used for any teacher statement which indicated uncertainty (e.g. 'I'm unsure'), and the code '**NO'** was used when the teacher clearly stated that they did not implement any pedagogical strategies for SRL.

Table A.3. Codes related to epistemic cognition for teaching.

Codes related to epistemic cognition for teaching: Epistemic stances/Ideals, Epistemic Virtues/Vices and Epistemic Value.

Coding category 1	Coding category 2	Coding category 3	Description and Justification (Evidence from literature)	Example text segments
Epistemic stances/ideals EI This code typically relates to the following TEC-SRL question: *How do you know if students have achieved deeper knowledge about SRL?*	-	-	Any statement that indicates a form of criteria for what a teacher would look for when assessing SRL knowledge (in planning or evaluation) "epistemic ideals, which are the standards that a person uses to evaluate whether epistemic ends have been achieved" (Chinn et al., 2014, p. 426). o Multiple sources (perception, introspection, memory, reasoning, testimony)? o Justificatory standards (amount of data explained, coherence of explanation with existing knowledge and beliefs) "beliefs about justification and structure are collapsed into "epistemic ideals" used to judge knowledge claims" (Buehl & Fives, 2016, p. 254)	[I know students have achieved a deeper knowledge about SRL when…] "They are keen to share their knowledge with the class." "By using the SRL worksheets [i.e., SRL Process Protocols], I can see a comparison of the level of thought students are now able to utilise compared to the 'before SRL' condition in their reflections of the effectiveness of their strategies. Note: Most "PCK-A" statements were also coded as EI.
Epistemic virtues and vices/Reflexive disposition RD This code typically relates to the think-aloud transcripts	-	-	Any statement that indicates a teachers' reflexive disposition "Epistemic virtues are praiseworthy dispositions of character that aid the attainment of epistemic aims, such as intellectual courage and open-mindedness. In contrast, epistemic vices are those dispositions that hinder the achievement of epistemic aims." (Chinn et al., 2011, p. 142)	"Thinking about it now has also made me think that I need to make sure I reinforce the skills that I want the other girls to be doing when they independently are watching a video." Note: I coded this statement as RD as it indicates a reflexive quality in the statement "Thinking about it now has also made me think"
Epistemic value EV	-	-	Any statements that indicate that the participant valued SRL, developing student knowledge about SRL, or their own knowledge about their students' SRL. "Epistemic value refers to the worth [value] of particular epistemic achievements" (Chinn et al., 2011, p. 142) E.g. "a person who believes that scientific knowledge is worth attaining because it supports economic growth has a belief that scientific knowledge is valuable for practical reasons" (Chinn et al., 2011, p. 142) Fives et al., (2017) included epistemic value within the Teacher's Self System	No text segments coded to this category

Table A.4. Codes related to perception of enablers and barriers to teaching of SRL

Codes for perception (middle-leaders and teachers) of enablers and barriers to implementation of explicit teaching of SRL strategies.

Coding category 1	Coding category 2	Coding category 3	Description and Justification (Evidence from literature)	Example text segments
Factors related to sustained implementation SI These codes typically relate to the following TEC-SRL questions: *What is the most important factor for sustained implementation of explicit teaching of SRL? Please explain.* *What is the most significant barrier to sustaining explicit teaching of SRL? Please explain.*	Priority/ Administrator support SI-Pri	-	School wide expectation/priority Expectations of staff Level of support compared to other potential practices Tied to school values? "integrating the practice into existing or new school and district initiatives" (e.g. embedded in planning documentation) (Turri et al., 2016)	"A consistent [school-wide] strategy where there is accountability for using SRL teaching strategies." "Probably the degree to which it is embedded and expected to be used by the school management"
	[Staff] Buy-In SI-Buy	-	Negative beliefs regarding the practice Desire to maintain status quo/Lack of interest in intervention Intervention principles are in opposition to staff beliefs Teachers' motivation? Teachers' attitudes? (Turri et al., 2016)	"Opt in from staff" "Motivation from a teacher to do the best job they can - this is not always evident." "An openness to learning new methods of teaching."
	[Staff] capacity to implement SI-SC	Time SI-SC-Tim	Sufficient time for implementation Perception that intervention aligns with regular routines and is not perceived as additional burden Perception of Efficiency (Time) – positive outcomes vs. effort required (Turri et al., 2016)	"A lack of time to implement new strategies in the classroom and to train staff on how to use these/ a belief that next year there will be another 'fad'." "Time constraints"
		Knowledge SI-SC-Kno	Inadequate training/Access to ongoing PD Lack of ongoing technical assistance Few staff members trained (Turri et al., 2016)	"Teacher knowledge and understanding on the benefits of SRL to students and staff" "Consistent professional development in the area"
	Community of practice SI-CoP	-	Networking and connections to peers implementing SRL teaching (as opposed to simply receiving training from an external) Opportunities for peer assessment (Andreou, McIntosh, Ross, & Kahn, 2015)	"Opportunities to work with peers in achieving and assessing goals" "Receiving feedback."
	Effectiveness/ SI-Eff	-	Effects of the practice on student outcomes (Evidence from student progress) Perceived effects by school personnel Evidence-based Intervention implemented with fidelity (McIntosh & Turri, 2013)	"As with all teaching concepts, consistently and maintenance." "Observing improvement in students' ability to self-regulate and getting positive feedback from them regarding that style of learning."
	Competing initiatives SI-Com	-	Teaching VCE Balance between curriculum/content and SRL strategies Competing teaching foci (Turri et al., 2016)	"to find a balance between teaching content and strategies" "the pressure to get through content"

Table A.5. Process codes related to teachers' epistemic cognition about SRL

Coding category 1	Coding category 2	Coding category 3	JUSTIFICATION (EVIDENCE FROM LITERATURE)	Example text segments
	Epistemic aims for learners (develop Strategies) sEA-L	Knowledge, Understanding or True belief related to SRL strategies (and broader SRL process) sEA-L-Kno sEA-L-Und sEA-L-Tru	Any statement that represents a teacher setting a goal to DEVELOP student knowledge, understanding or true belief about SRL "Epistemic aims are a subset of the goals people adopt, specifically those goals related to inquiry and finding things out. Epistemic aims discussed by philosophers include knowledge, understanding, and true beliefs" (Chinn et al., 2011, p. 147) "In the context of teaching, we expand upon Chinn et al.'s (2011, 2014) definition of epistemic aims to include goals related to assisting or scaffolding others (i.e. students) in acquiring knowledge, understanding, and true belief" (Buehl & Fives, 2016, p. 252)	"So what I'm hoping for is using the beep strategy today will help the girls to maintain their focus during that time" - Note, this text segment was coded as sEA-L-Kno, because the aim here is to develop student procedural knowledge of the 'beep strategy' with the aim of improving attention focusing. "I'm also wanting them to understand that if you don't get something at some point during watching the video that you can rewind, go back, listen that also at any point you can pause, take notes, you can come and ask the teacher." - Note, this text segment was coded as sEA-L-Kno. Although the teacher uses the word 'understand', this is not understanding as defined by the epistemic cognition literature reviewed. Therefore, it is coded as knowledge (of a resource management strategy).
	Epistemic aim for self (assess) sEA-S	Knowledge, Understanding or True belief related to student's knowledge of SRL strategies (and broader SRL process) sEA-S-Kno sEA-S-Und sEA-S-Tru	Any statement that represents a teacher setting a goal to ASSES student knowledge about SRL "Epistemic aims are the knowledge-oriented goals and objectives held by individuals. These aims have been described in terms of what individuals hope to achieve or the nature of their learning tasks such as developing knowledge, understanding, explanation, justification, true belief, avoidance of false belief, useful scientific models, and wisdom (Chinn et al., 2011; Chinn et al., 2014)" (as cited in Fives et al., (2017, p. 273).	No text segments coded to this category

[Consideration and Evaluation of] epistemic matters related to SRL cEM	For learners cEM-L	-	Any statement that represents a teacher considering epistemic matters related to the DEVELOPMENT of student knowledge about SRL "Consideration and evaluation of epistemic matters refers to the contemplation of information, knowledge, and knowing (identified by the task and domain) with respect to the dimensions of knowledge, namely, source, structure, certainty, and justification (Buehl & Fives, 2016; Hofer, 2016)" (Fives et al., 2017)(p.274-275) "Knowledge may be evaluated on a range of continua, but most approaches include considerations of the (a) source of knowledge as derived from authority or personal construction (e.g., Hofer, 2000); (b) certainty/stability of knowledge perceived as certain and unchanging or tentative and evolving (e.g., Schommer, 1990; Schraw et al., 1995); (c) structure of knowledge as discrete and simple or as integrated and complex (e.g., Buehl, Alexander, & Murphy, 2002); and (d) justification of knowledge through appeals to authority, personal justification, and the personal evaluation of evidence to determine if knowledge requires revision or if the claim stands (e.g., Greene et al., 2008; Hofer, 2000)." (Fives et al., 2017)(p.274-275)	"I'm also planning it this way because I want to promote as much self-regulation as possible. I think mathematics is a really good way to do it because there's a definite answer in a definite way of doing things so there is often instruction time but I don't need to be the one to do that instruction" – Note, this is an example of EM-L, as the teacher is expressing an epistemic belief about the structure of mathematics knowledge (definite answer) and therefore a suitable context for students to engage in self-regulated learning At this point, no other text segments have been coded to this category
	For self cEM-S	-	Any statement that represents a teacher considering epistemic matters related to the DEVELOPMENT of student knowledge about SRL	No text segments coded to this category
Selecting reliable processes for achieving epistemic aims sRP These codes typically relate to the think-aloud transcripts/lesson plans Note: All RP codes will also be coded as PCK as it indicates knowledge of a	For learners (strategy instruction) sRP-L Any statement that represents a teacher selecting a pedagogical strategy to DEVELOP student knowledge about SRL	-	"This component concerns the processes (e.g., cognitive and social processes, inquiry methods) by which knowledge (and other epistemic aims) are achieved. For example, a student might regard extended argumentation with peers as a good process for developing knowledge of history" (Chinn et al., 2011, p. 142) "causal schemas specifying the processes by which knowledge and other epistemic products are reliably produced" (Chinn et al., 2014, p. 426) "These schemas may manifest themselves as beliefs (which again may be tacit)" (Chinn et al., 2014, p. 426)	"this time the mini lesson will be on self-regulated learning, so they'll come in and they'll write what they want to achieve in this lesson on the back of the strategy recording table that I'll give them and that way they can refer back to it and see am I achieving this goal." – Note, this text segment was coded to RP-L as the selection of a reliable process (i.e. explicit prompting in SRL process). Additionally it was coded as PCK-S-Exp. "So part of my strategy for that is to actually get them to watch it, to write notes down and pause and say "can you stop there, I need to write a note" or can you stop there, I need to ask you a question about it" – Note, this text segment is coded as sRP-L, as it is the teacher selecting a pedagogical strategy. It is not clear whether this strategy is explicit or implicit, so it will also be coded as PCK-S-Imp

pedagogical strategy	For self (assess) sRP-S Any statement where a teacher selects a pedagogical strategy to ASSESS student knowledge about SRL	-	"This component concerns the processes (e.g., cognitive and social processes, inquiry methods) by which knowledge (and other epistemic aims) are achieved. For example, a student might regard extended argumentation with peers as a good process for developing knowledge of history" (Chinn et al., 2011, p. 142) "causal schemas specifying the processes by which knowledge and other epistemic products are reliably produced" (Chinn et al., 2014, p. 426) "These schemas may manifest themselves as beliefs (which again may be tacit)" (Chinn et al., 2014, p. 426)	No text segments coded to this category

Appendix P. Middle-Leader Engagement in PLC-ER

School middle-leaders' engagement in the PLC-ER about SRL and data collection components.

	Before				PLC-ER about SRL																					After				9 months after			
Participant	Questionnaire	Think-Aloud	Submitted lesson plan	Lesson Observation	Professional Education session 1	Think-Aloud	Submitted lesson plan	Lesson Observation	Feedback (optional)	Professional Education	Think-Aloud	Submitted lesson plan	Lesson Observation	Feedback (optional)	Professional Education	Think-Aloud	Submitted lesson plan	Lesson Observation	Feedback (optional)	Professional Education	Think-Aloud	Submitted lesson plan	Lesson Observation	Feedback (optional)	Professional Education	Questionnaire	Think-Aloud	Submitted lesson plan	Lesson Observation	Questionnaire	Think-Aloud	Submitted lesson plan	Lesson Observation
ML1	1	1	0	1	0	1	1	1	1	1	0	0	1	1	1	0	1	0	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0
ML2	1	1	0	1	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
ML3	1	1	0	1	0	1	1	1	1	1	0	0	0	0	0	1	1	1	0	0	0	0	0	0	1	0	1	1	1	0	1	0	1
ML4	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	NE	NE	NE	NE
ML5	1	1	0	1	0	1	1	1	1	0	1	1	1	1	1	1	1	1	0	0	1	1	1	0	1	1	1	0	1	1	1	0	1
ML6	1	1	0	0	1	1	0	1	1	1	0	0	0	0	1	0	1	1	1	0	0	0	0	0	1	1	0	0	1	A	A	A	A
ML7	1	1	0	0	1	1	0	1	1	1	1	0	1	1	1	1	0	1	1	1	0	1	1	1	1	1	0	0	1	1	0	0	0
ML8	1	1	0	1	1	1	1	1	1	1	1	0	1	1	1	1	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1
ML9	0	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	1
ML10	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	0	1	1	0	1	0	1
ML11	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	1	1	1	1	0	1	1	0	0	0	A	A	A	A
ML12	1	1	0	0	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0
ML13	1	1	0	1	1	1	1	1	1	1	1	0	1	1	1	1	0	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0
ML14	1	1	0	1	1	0	0	1	1	0	1	0	1	0	1	0	0	0	0	1	0	0	0	0	1	W	W	W	W	W	W	W	W
ML15	1	1	0	1	1	1	0	1	1	1	1	0	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
ML16	1	1	0	0	1	1	0	1	1	1	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	NE	NE	NE	NE

0 = Not completed; 1 = Completed; A = Absent; W = Withdrawn; NE = No longer employed

Appendix Q. Examples of Text Segments coded to 'Content Knowledge'

Examples of school middle-leaders' text segments coded to the 'content knowledge about SRL' category.

Quality dimensions	1	2	3	4	5
Extent	**One text segment** coded *E.g., "Initiatives taken by a learner to advance, monitor or progress the development of their learning"* ***(ML6, Before PLC-ER)***	**Two text segments** coded *E.g., "How to check their own understandings"; "How to identify flaws or missing knowledge and skills in their own learning"* ***(ML11, Before PLC-ER)***	**Three text segments** coded *E.g., "Need to know a range of strategies to use in the classroom"; "how to organise their time properly"; "and how to set effective goals"* ***(ML4, Before PLC-ER)***	**Four text segments** coded *E.g., "How to set their own goals"; "and plan for their own learning"; "A variety of learning strategies to maintain focus"; "How to maintain motivation"* ***(ML8, After PLC-ER)***	**Five or more text segments** coded *E.g., "How to reflect on their thinking and learning strategies"; "How to time manage"; "How to continuously evaluate their learning. [i.e. monitoring and evaluating]"; "How to set goals"; "and evaluate their goals"* ***(ML4, After PLC-ER)***
Well-foundedness	Text segments **do not cohere** with the evidence. *E.g., "Clear scope and sequence"* ***(ML6, Before PLC-ER)***	Text segments **loosely cohere** with the evidence *E.g., "they need to be taught that that can become more effective learners by developing their learning skills and behaviours"* ***(ML2, After PLC-ER)***	Text segments **somewhat cohere** with the evidence *E.g., "[Strategies for] how to check their own understandings"; "How to identify flaws or missing knowledge and skills in their own learning"* ***(ML11, Before PLC-ER)***	Text segments **moderately cohere** with the evidence *E.g., "Need to know a range of strategies to use in the classroom"; "how to organise their time properly"; "and how to set effective goals [goal-setting]"* ***(ML4, Before PLC-ER)***	Text segments **accurately cohere** with the evidence *E.g., The process of setting goals, planning how you will achieve them and setting those plans in motion, evaluating whether you have achieved your goals and whether your strategies worked and starting all over again in a reflective cycle.* ***(ML1, 9-months after PLC-ER)***
Structure	Text segments are listed with **no connections** (i.e. Fragmented knowledge) *E.g., "Time"; "Environment"; "Goal Setting"; "Peer Influence / Collaboration"* ***(ML6, After PLC-ER)***	Text segments are listed, with **limited connections** *E.g., "How to check their own understandings"; "How to identify flaws or missing knowledge and skills in their own learning"* ***(ML11, Before PLC-ER)***	Text segments are listed with **some connections** *E.g., "How to set their own goals"; "and plan for their own learning"; "A variety of learning strategies to maintain focus"; "How to maintain motivation"* ***(ML8, After PLC-ER)***	Text segments are listed with **moderate connections** *E.g., "Self-regulated learning is the ability in the individual to pace their own learning activity through planning and a level of consciousness of the learning process, in a reflective sense, that enables students to moderate their own*	Text segments are listed and **closely connected/interrelated** *E.g., "I conceptualize SRL as an ability for learners to be able to work independently and effectively to gain understandings and skills without explicit direction from a teacher/facilitator. It requires a combination of skills such as organisation,*

				learning activities" ***(ML14, Before PLC-ER)***	*self-efficacy, an understanding of how to access appropriate resources, an ability to ask good questions, an ability to set targets and an understanding of the overall course goals and objectives"* ***(ML13, Before PLC-ER)***
Complexity	Text segments provide **no detail or description** of an SRL related concept. *E.g., "reflection, setting goals, monitoring those goals"* ***(ML4, Before PLC-ER)***	Text segments provide **little detail or description** of an SRL related concept *E.g., "creating and implementing a plan"* ***(ML1, After PLC-ER)***	Text segments provide **some detail or description** *E.g., Self-regulated learning is a student's capacity to make informed choices and employ effective strategies at various stages of their learning that enable them to plan, monitor and evaluate their learning effectively.* ***(ML2, 9-months after PLC-ER)***	Text segments provide **a moderate description** of an SRL related concept *E.g., "The process of setting goals, planning how you will achieve them and setting those plans in motion, evaluating whether you have achieved your goals and whether your strategies worked and starting all over again in a reflective cycle"* ***(ML2, 9-months after PLC-ER)***	Text segments provide **extensive detail or an extensive description** of an SRL related concept. *E.g., "SRL is the process of planning, monitoring and evaluating one's own learning process. These processes demand metacognitive awareness as well as cognitive skills and strategies"; "I think this requires an understanding of both the 'nuts and bolts' of cognition - a mental model of how learning happens - as well as the range of strategies that can be employed in different situations"* ***(ML9, After PLC-ER)***
Generativity	Only **one type** of coded text segment listed *E.g., "Initiatives taken by a learner to advance, monitor or progress the development of their learning" (***ML6, Before PLC-ER)***	**Limited range** of text segments (i.e., two different types of coded text segments) *E.g., "A process of setting goals"; "creating and implementing a plan"; "and evaluating the outcome"* ***(ML1, After PLC-ER)***	**Some range** of text segments (i.e., three different types of coded text segments) *E.g., "Need to know a range of strategies to use in the classroom"; "how to organise their time properly"; "and how to set effective goals"* ***(ML4, Before PLC-ER)***	**Moderate range** of text segments (i.e., four different types of coded text segments) *E.g., "How to set their own goals [goal-setting]"; "and plan for their own learning [planning]"; "A variety of learning strategies to maintain focus [attention focusing]"; "How to maintain motivation"* ***(ML8, After PLC-ER)***	**Broad range** of text segments (i.e., Five or more different types of coded text segments) *E.g., "they need strategies to manage their time"; "scaffolds to develop achievable goals"; "know what keeps them on task, what distracts them and can self-manage this"; "intrinsic motivation - what motivates them as a learner*

					*and how to keep going when that motivation wanes"; "Time to practice these strategies" (**ML1, 9-months after PLC-ER)***
Variety of representational format	Text segments reflect a **single** cognitive representation *E.g., "Learning directed by meta-cognitive practices"; "i.e., reflection"; "evaluating our 'toolboxes' for different learning activities"; "setting goals"; "and monitoring those goals" **(ML4, Before PLC-ER)***	Text segments reflect **limited** diversity in cognitive representations (i.e., two) *No available example*	Text segments reflect **some** diversity in cognitive representations (i.e., three) *No available example*	Text segments reflect a good diversity in cognitive representations (i.e., four) *No available example*	Text segments reflect **many and diverse** cognitive representations (i.e., five or more) *No available example*

Appendix R. Examples of Text Segments Coded to 'Pedagogical Content Knowledge'

Examples of school middle-leaders' text segments coded to the 'pedagogical content knowledge about SRL' category.

Quality dimensions	1	2	3	4	5
Extent	**One text segment** coded *E.g., 'Observation [of student SRL behaviour]'* ***(ML3, Before PLC-ER)***	**Two text segments** coded *E.g., 'explicit teaching to introduce process and various strategies'; 'teacher modeling - explain what and why you are doing things'* ***(ML1, Before PLC-ER)***	**Three text segments** coded *E.g., 'Transparency about SRL within the curriculum'; 'Small activities that engage students in reflection about their learning'; 'Ensuring their SRL has achievable and purposeful goals or outcomes'* ***(ML8, Before PLC-ER)***	**Four text segments** coded *E.g., 'Students need to be explicitly taught strategies and then be given opportunities to put them into practice'; 'They then need time to reflect, discuss their strategies and what they could do better'; 'It could also help to observe other peers SRL strategies/techniques.'; 'students could log time worked on task [self-recording task]'* ***(ML2, Before PLC-ER)***	**Five or more text segments** coded *E.g., 'Teach SRL strategies alongside 'subject specific' content'; 'Teachers should also model use of SRL strategies'; 'give them examples of how they can be applied in [other] areas'; 'Having students teach an SRL strategy to another would be extremely effective'; 'Having students log their strategy use in their workbooks would also be effective'; 'Sharing of effective strategy use during plenaries would also be a form of effective assessment'* ***(ML2, 9-months after PLC-ER)***
Well-foundedness	Text segments **do not cohere** with the evidence *No available example*	Text segments **loosely cohere** with the evidence *E.g., 'Observation [of student SRL behaviour]'* ***(ML3, Before PLC-ER)***	Text segments **somewhat cohere** with the evidence *E.g., 'Modelling is important'; 'setting clear targets'; 'giving students a repertoire of skills (organisational, diagnostic etc.).'; 'tracking progress via observing'; 'checking in with students – asking students to submit a learning plan'* ***(ML13, Before PLC-ER)***	Text segments **moderately cohere** with the evidence *E.g., 'One strategy at a time, then multiple times to embed the strategy, slowly, the students need time to practice strategies taught [with] common language used regularly'; 'Use of evaluation sheets'; 'Discussion after lessons'* ***(ML1, After PLC-ER)***	Text segments **accurately cohere** evidence identified in the SRL literature *E.g., 'It is important to explicitly teach SRL in context - within a lesson already planned with a subject/content learning intention. This indicates the students that within a lesson you can have a content or subject focus, as well as an SRL focus. E.g. A strategy to monitor attention while learning how to add decimals. The student has to be attentive when listening*

					to instructions and when working independently during the lesson.' ***(ML2, After PLC-ER)***
Structure	Text segments are listed but with **no connections** (i.e. Fragmented knowledge) *E.g., 'Modelling is important'; 'setting clear targets'; 'giving students a repertoire of skills (organisational, diagnostic etc.).'; 'tracking progress via observing'; 'checking in with students – asking students to submit a learning plan'* ***(ML13, Before PLC-ER)***	Text segments are listed, with **limited connections** *E.g., 'Transparency about SRL within the curriculum'; 'Small activities that engage students in reflection about their learning'; 'Ensuring their SRL has achievable and purposeful goals or outcomes'* ***(ML8, Before PLC-ER)***	Text segments are listed with **some connections** *E.g., 'One strategy at a time, then multiple times to embed the strategy, slowly, the students need time to practice strategies taught [with] common language used regularly'; 'Use of evaluation sheets'; 'Discussion after lessons'* ***(ML1, After PLC-ER)***	Text segments are listed with **moderate connections** *E.g., 'Students need to be explicitly taught strategies and then be given opportunities to put them into practice'; 'They then need time to reflect, discuss their strategies and what they could do better'; 'It could also help to observe other peers SRL strategies/techniques.';* ***(ML2, Before PLC-ER)***	Text segments are listed and **closely connected/interrelated** *E.g., 'I believe that while SRL strategies need to be explicitly taught, especially when teaching for transfer, I also believe that students need the opportunity to apply and practice using strategies within an authentic context/task. Abstract approaches which are disconnected from 'real' learning tasks do not seem to work in my experience.'* ***(ML9, After PLC-ER)***
Complexity	Text segments provide **no detail or description** of the SRL related concept *E.g., 'Observation'* ***(ML3, Before PLC-ER)***	Text segments provide **little detail or description** of an SRL related concept *E.g., 'tracking progress via observing'; 'checking in with students'* ***(ML13, Before PLC-ER)***	Text segments provide **some detail or description** *E.g., 'Transparency about SRL within the curriculum'; 'Small activities that engage students in reflection about their learning'; 'Ensuring their SRL has achievable and purposeful goals or outcomes'* ***(ML8, Before PLC-ER)***	Text segments provide **a moderate description** of an SRL related concept *E.g., 'SRL instruction needs to occur in the context of an authentic task, so that students have the opportunity to apply new SRL knowledge/strategies to a meaningful context. Without application, strategies do not become embedded into students' regular learning routines and habits'* ***(ML9, 9-months after PLC-ER)***	Text segments provide **extensive detail or an extensive description** of an SRL related concept. *E.g., 'It is important to explicitly teach SRL in context - within a lesson already planned with a subject/content learning intention. This indicates the students that within a lesson you can have a content or subject focus, as well as an SRL focus. E.g. A strategy to monitor attention while learning how to add decimals. The student has to be attentive when listening to instructions and when working independently during the lesson.'* ***(ML2, After PLC-ER)***

Generativity	Only **one type** of coded text segment listed *E.g., 'Observation'* ***(ML3, Before PLC-ER)***	**Limited range** of text segments (i.e., two different types of coded text segments) *E.g., 'explicit teaching to introduce process and various strategies'; 'teacher modeling - explain what and why you are doing things'* ***(ML1, Before PLC-ER)***	**Some range** of text segments (i.e., three different types of coded text segments) *E.g., 'Transparency about SRL within the curriculum'; 'Small activities that engage students in reflection about their learning'; 'Ensuring their SRL has achievable and purposeful goals or outcomes'* ***(ML8, Before PLC-ER)***	**Moderate range** of text segments (i.e., four different types of coded text segments) *E.g., 'Students need to be explicitly taught strategies and then be given opportunities to put them into practice'; 'They then need time to reflect, discuss their strategies and what they could do better'; 'It could also help to observe other peers SRL strategies/techniques.'; 'students could log time worked on task [self-recording task]'* ***(ML2, Before PLC-ER)***	**Broad range** of text segments (i.e., Five or more different types of coded text segments) *E.g., 'Students need to be explicitly taught strategies and then be given opportunities to put them into practice'; 'They then need time to reflect, discuss their strategies and what they could do better'; 'It could also help to observe other peers SRL strategies/techniques.'; 'observation / interviews'; 'Students could log time worked on tasks - write reflections on how they have used their time & how effective they were in achieving their goals'* ***(ML2, Before PLC-ER)***
Variety of representational format	Text segments reflect a **single** cognitive representation *E.g., 'Observation'* ***(ML3, Before PLC-ER)***	Text segments reflect **limited** diversity in cognitive representations (i.e., two) *No available example*	Text segments reflect **some** diversity in cognitive representations (i.e., three) *No available example*	Text segments reflect a good diversity in cognitive representations (i.e., four) *No available example*	Text segments reflect **many and diverse** cognitive representations (i.e., five or more) *No available example*

Appendix S. Examples of Text Segments Coded to Epistemic Ideals

Examples of middle-leaders' text segments coded to the 'epistemic ideals about SRL' category

Quality dimensions	1	2	3	4	5
Extent	**One** text segment coded *E.g., 'they think about these four elements on their own as they are writing their words and not waiting to get teachers feedback'* ***(LT10, After session 1)***	**Two** text segments coded *E.g., 'that they've provided feedback'; 'they're utilizing their feedback that they've received'* ***(LT13, After session 2)*** *E.g., 'monitor... [their] concentration and attention during independent work time, how often they are on or off task and for what reasons';* ***(LT2, After session 2)***	**Three** text segments coded *E.g., '[they] change their learning habits… and use [help-seeking strategy] rather than constantly coming to ask me questions'; 'I'll be able to revisit this success criteria at the end and we will be able to identify that they have achieved each of the success criteria'; 'if they can say… yes I have done number one, I've done number two and I've done number three or on the way to doing they may have completed one and are currently working on number two then I think that they are self-regulating'* ***(LT2, After session 1)***	**Four** text segments coded *No available example*	**Five or more** text segments coded *E.g., 'use the short-term goal strategy to help motivate us and lessons'; 'very active or engaged or focused in the beginning'; 'set themselves a goal for the lesson'; 'What sort of things they can do within the lesson to achieve the goal and I suppose the actions they'll actually ... they will actually be self-regulation strategies as well'; 'removing all distractions from their hands or around them whenever they're listening to instructions'; 'they'll come and sit in front of the teacher when they're listening instructions'; 'a variety of different things that they will suggest to help them achieve their goal'; 'whether or not they've actually understood how to set a goal'; 'If they've chosen the correct strategies to focus on to really get them towards achieving that goal'* ***(LT2, 9-months after 3R-EC-PLC)***
Well-foundedness	Text segments **do not cohere** with the evidence	Text segments **loosely cohere** with the evidence *E.g., 'they often just highlight a whole page rather than being more judicious with*	Text segments **somewhat cohere** with the evidence *E.g., 'to go and find that information themselves rather than coming and asking me for exemplars'; 'they go and*	Text segments **moderately cohere** with the evidence *E.g., 'looking at what strategies did the students choose to proofread their work such as the acronym*	Text segments **accurately cohere** with the evidence *E.g., '[the students are] using it i.e., [the resource/help-seeking strategy]'; 'accessing [it] at home but… [also]*

		what they're highlighting' ***(LT13, Before 3R-EC-PLC)***	*look online on our shared OneNote first and then if they're not able to find exemplars there then either they try to look for one themselves or they come and ask me'; 'they can use it rather than coming up to the teacher for help'* ***(LT1, After session 1)***	*of…'; '[can] explain those strategies to me'; '[criteria of self-questioning -] if I have a question with 'Why'… - what would be the key words to use in the answer such as... 'Because'. How do I elaborate my answers? How can I expand to show my range of vocabulary? And finally, what steps do I need to take to proofread my work accurately?'* ***(LT7, After session 3)***	*accessing it throughout the lesson before they come to the teacher'; 'she really struggles with focus and is always on her computer doing the wrong thing'; 'move away from their friends'; 'Not focus/daydreaming'; 'again asking for help from a teacher'; 'they've completed the [self-recording]] sheet and made a goal based on the results'* ***(LT3, After session 3)***
Structure	Text segments are listed with **no connections** (i.e. Fragmented knowledge) *No available example*	Text segments are listed with **limited connections** *E.g., 'their achievements at the end in terms of what they learnt from the lesson in and what they can show in terms of their learning in their probability project because most questions are open-ended and they can move on and continue to engage with the question'* ***(LT16, After session 1)***	Text segments are listed with **some connections** *E.g., 'So how well do they understand the amount of work that they need to complete on the way to getting the project finished in relation to where they currently are up to now and how are they going to bridge the time and space between now and when it is due.'; 'assessing their work against the rubric and checklists for the task to see if they themselves can identify strengths and weaknesses within their own within their own work.'* ***(LT11, After session 2)***	Text segments are listed with **moderate connections** *E.g., '[they] change their learning habits… and use [help-seeking strategy] rather than constantly coming to ask me questions'; 'I'll be able to revisit this success criteria at the end and we will be able to identify that they have achieved each of the success criteria'; 'if they can say… yes I have done number one, I've done number two and I've done number three or on the way to doing they may have completed one and are currently working on number two then I think that they are self-regulating'* ***(LT2, After session 1)***	Text segments are **closely related or interconnected** *E.g., 'use the short-term goal strategy to help motivate us and lessons'; 'very active or engaged or focused in the beginning'; 'set themselves a goal for the lesson'; 'What sort of things they can do within the lesson to achieve the goal and I suppose the actions they'll actually ... they will actually be self-regulation strategies as well'; 'removing all distractions from their hands or around them whenever they're listening to instructions'; 'they'll come and sit in front of the teacher when they're listening instructions'; 'a variety of different things that they will suggest to help them achieve their goal'; 'whether or not they've actually understood how to set a goal'; 'If they've chosen the correct strategies to focus on to really get them towards achieving that goal'* ***(LT2, 9-months after 3R-EC-PLC)***

Complexity	Text segments provide **no detail or description** *E.g., 'that they've provided feedback'; 'they're utilizing their feedback that they've received'* ***(LT13, After session 2)***	Text segments provide **little detail or description** *E.g., 'to go and find that information themselves rather than coming and asking me for exemplars'; 'they go and look online on our shared OneNote first and then if they're not able to find exemplars there then either they try to look for one themselves or they come and ask me'; 'they can use it rather than coming up to the teacher for help'* ***(LT1, After session 1)***	Text segments provide **some detail or description** *E.g., 'So how well do they understand the amount of work that they need to complete on the way to getting the project finished in relation to where they currently are up to now and how are they going to bridge the time and space between now and when it is due.'; 'assessing their work against the rubric and checklists for the task to see if they themselves can identify strengths and weaknesses within their own within their own work.'* ***(LT11, After session 2)***	Text segments provide **moderate detail or description** *E.g., 'there'll… be using OneNote as a resource'; 'It also stops them from going to a teacher to ask for help-they're able to help themselves'; 'students who are using OneNote to recap the learning from yesterday or who use the resources to guide them in this lesson'; 'who goes straight into it who opens into that tab who's going to access the content to help them further with their learning'; 'all the girls using it within every lesson'* ***(LT3, After session 1)***	Text segments provide **extensive detail or an extensive description** *E.g., '[the students are] using it i.e., [the resource/help-seeking strategy]'; 'accessing [it] at home but… [also] accessing it throughout the lesson before they come to the teacher'; 'she really struggles with focus and is always on her computer doing the wrong thing'; 'move away from their friends'; 'Not focus/daydreaming'; 'again asking for help from a teacher'; 'they've completed the [self-recording]] sheet and made a goal based on the results'* ***(LT3, After session 3)***
Generativity	**Only one type** of coded text segment listed *E.g., 'they often just highlight a whole page rather than being more judicious with what they're highlighting'* ***(LT13, Before 3R-EC-PLC)***	**Limited range** of text segments (i.e., two different types of coded text segments) *E.g., '[they] change their learning habits… and use [help-seeking strategy] rather than constantly coming to ask me questions'; 'I'll be able to revisit this success criteria at the end and we will be able to identify that they have achieved each of the success criteria'* ***(LT2, After session 1)***	**Some range** of text segments (i.e., three different types of coded text segments) *No available example*	**Moderate range** of text segments (i.e., four different types of coded text segments) *No available example*	**Broad range** of text segments (i.e., Five or more different types of coded text segments) *E.g., '[the students are] using it i.e., [the resource/help-seeking strategy]'; 'accessing [it] at home but… [also] accessing it throughout the lesson before they come to the teacher'; 'she really struggles with focus and is always on her computer doing the wrong thing [expects change in this behaviour]'; 'move away from their friends'; 'Not focus/daydreaming'; 'again asking for help from a teacher'; 'they've completed the [self-recording]] sheet and made a goal based on the results'* ***(LT3, After session 3)***

Variety of representational format	Text segments reflect a **single** cognitive representation *E.g., 'they think about these four elements on their own as they are writing their words and not waiting to get teachers feedback'* ***(LT10, After session 1)***	Text segments reflect a **limited** diversity in cognitive representation (i.e., two) *No available example*	Text segments reflect **some** diversity in cognitive representations (i.e., three) *No available example*	Text segments reflect a good diversity in cognitive representations (i.e., four) *No available example*	Text segments reflect **many and diverse** cognitive representations (i.e., five or more) *No available example*