COLLABORATING WITH UNIVERSITY INSTRUCTORS TO FOSTER SELF-REGULATED

LEARNING IN SCIENCE UNDERGRADUATE COURSES

by

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Abstract

Learning at university demands students to be more independent learners than learning in high school and many undergraduates struggle academically because they have not mastered the skills to take control of their learning. Moreover, contextual factors may limit their engagement in productive forms of learning. Most institutions offer academic supports to help students overcome academic challenges and navigate university learning, which students must proactively seek out. Often students are unaware such supports exist until after they experience difficulties. Promoting student engagement in self-regulated learning (SRL) in content courses would make supports for learning more accessible to the wider postsecondary population. However, the successful and sustainable implementation of such changes to instructional practice requires course instructors' involvement.

With the goal of advancing teaching concerning SRL in postsecondary settings, my research sought to: document how a group of university instructors included SRL supportive practices (SRLSPs) in their undergraduate courses; probe instructors' and students' perspectives about SRL supports; and examine how instructors' engagement in SRL-focused inquiry enabled them to enhance their teaching practice. Using a multiple-case study design, I partnered with five Science instructors at a Canadian university to form a Community of Inquiry (CoI). Through individual and collaborative inquiry, they learned about, designed, and implemented SRLSPs in a course of their choosing. Data collected revealed instructors' SRL-focused teaching and their insights about the experiences of teaching for SRL and engaging in inquiry. Instructors' data was enriched by interviews with a small group of students about their learning experience in these SRL-informed courses.

Findings suggested that the instructors infused their teaching with SRLSPs in meaningful/context sensitive ways and observed general positive effects on students' participation and performance. Both the instructors and students perceived the implementation of SRLSPs as important to make a difference in students' learning. The instructors perceived systemic, student, and instructor factors afforded and/or constrained their efforts at teaching for SRL and that the CoI model and inquiry processes were productive, validating, and led to sustainable changes to their practice. Contributions to theory, research,

and practice about SRL-focused teaching in undergraduate courses as well as considerations for future

research are discussed.

Lay Summary

I worked with five university instructors to support their students to develop deliberate, proactive, and adaptive approaches to learning, referred to as self-regulated learning. The instructors brought learning supports to their courses and reflected, on their own and as a group, about teaching to promote these learning skills. Some of their students shared their unique experiences with these supports.

Findings from my study showed that: (a) instructors designed and used practices supportive of self-regulated learning that fit the context of their courses; (b) instructors and students agreed supporting self-regulated learning in subject courses was helpful to make teaching and learning more accessible and inclusive; and (c) instructors' understanding about how to support self-regulated learning was informed through group discussions and personal reflection about their teaching, which enabled them to enhance to their teaching practice.

Preface

        This dissertation is an original intellectual product of the author, Silvia Mazabel Ortega. The research reported herein was covered by UBC Behavioural Research Ethics Board certificate of approval number H17-00037.

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Para Oli, Mon and Tomasi

Por darle color y perspectiva a mi vida!

Los quiero mucho.

Chapter One: Introduction

Cali was an academically and socially successful high school graduate who applied to postsecondary institutions across Canada to pursue a degree in Biology. She enrolled at a research-oriented university far from home because the program fit well with her interest in becoming a marine biologist. Given her successful academic experience in high school, she felt confident in her ability to cope with university demands. However, in her transition to university, Cali had to figure out living away from home, making new friends, and studying while simultaneously sustaining her mental, emotional, and physical wellbeing. She struggled to understand how to learn and be academically successful in this new context. Much of the learning occurred outside the classroom, in unsupervised sessions, with limited guidance from instructors, without a constant peer support network, and in an environment full of distractions.

Cali had difficulty managing her time to meet the multiple deadlines and expectations for her courses. Throughout the first term, she attended class, took notes, and rushed to finish assignments, thinking she had understood what she had to do. Despite her best efforts, she failed one course and obtained lower than expected grades on two more courses. She could not understand why the way she approached learning in high school was not working in this new context. Thinking less work would help, she took a reduced course load the following term. Despite this adjustment, she ended her first year on academic probation, stressed, and doubtful that she had the ability to attain an undergraduate degree. Following the suggestion of her academic advisor, Cali took a study habits workshop to help her learn strategies to complete assignments and prepare for exams. In subsequent years, Cali continued focusing on meeting course requirements and, while she obtained her undergraduate degree, she never acquired a solid understanding of *how* to learn or engage in deep and meaningful learning. Consequently, she was left feeling unprepared for life and work after university.

Cali is representative of many postsecondary students who, despite their success in high school, struggle to navigate learning at university because they have not mastered skills necessary to take control of and manage their learning (Bembenutty, 2011; Pintrich & Zusho, 2007). While some of these students

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have access to timely and effective supports (e.g., tutoring) that help them overcome pressing academic issues, other students continue to struggle and underachieve in their academic programs, not getting the hoped-for learning experience (Dembo & Seli, 2004; Lizzio & Wilson, 2013, Marks, 2018). Perhaps supports for learning are not available to them, they do not proactively access them, or, like Cali, they develop strategies that help them obtain the grades they need to get the degree but never engage deeply with learning or develop life-long learning skills. In addition, undergraduate teaching assumes that students know how to study and learn. So often, instructors do not offer opportunities for students to develop the skills they need to take charge of their learning and thrive at university (Hadwin & Winne, 2012; Wieman, 2017). Making supports for learning more accessible to the wider postsecondary population, by embedding them in content courses, can be a powerful way to foster student engagement in developing effective and meaningful learning skills. My study emerged from an interest in advancing accessible and inclusive learning strategies within university courses to mitigate the academic challenges that students like Cali encounter in navigating learning at university.

Who Are the Learners at Universities Today?

Top Canadian research universities enroll highly qualified students with well-rounded academic and personal profiles, like Cali (Times Higher Education, 2020). For example, undergraduate applicants to the Faculty of Science in these institutions require a high level of academic proficiency with admission grade point averages ranging between 85% and 94%, depending on the institution (BC HEADset, nd; Maclean's, 2018). Given their experience of academic success in high school and their admission to an undergraduate program, many students enter higher education trusting their preparedness to learn and thrive at university (Steiner, 2016). However, at the institution where my study was conducted, approximately 5% of undergraduate students end the academic year with low grade point averages (C – or D; 49.5 – 59.4% standing), around 2% end the year on academic probation, and about 3% fail the session (2015-2019 academic years[1]). While these proportions are small in relation to the total number of students

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[1] Data provided by the Office of Planning and Institutional Research (February, 2021). Approved through data access governance process #INC2129703

attending the university, they represent a sizable minority (e.g., approx. 5,200 students) who are struggling to learn and achieve their goals. Additionally, these statistics do not include students who are just 'getting by' but perhaps not getting the most out of their education (Marks, 2018).

Postsecondary students also bring diverse linguistic, cultural, immigration, historical, socioeconomic, and schooling experiences to Canadian universities (Kraglund-Gauthier et al., 2014; Michalski et al., 2017). For example, more than ever before, Indigenous, immigrant, and international students are enrolled in postsecondary programs (Statistics Canada, 2020a; 2020b). Likewise, colleges and universities are enrolling more first-generation students who may not have access to knowledge about the postsecondary culture and experience because they are the first person in their families to pursue an academic degree (Stansbury, 2017). University students are also more socioeconomically diverse than a few decades ago. In many industries, attaining a postsecondary degree is now a prerequisite to join the workforce. However, the cost of studying and living is high, forcing many students to work full or part-time while they complete their studies. Another layer of diversity in postsecondary education emerges from the implementation of inclusive education practices in North American elementary and secondary settings for the past two decades. Inclusive education offers students with disabilities opportunities to thrive academically and move on to postsecondary education programs (Kraglund-Gauthier et al., 2014; Scott et al., 2003). About 10% of postsecondary learners self-identify as having learning, mental health, physical and ongoing medical conditions that, without adequate support, could impact their learning experience and progress (Orr & Bachman Hammig, 2009). While the diversity of learners enriches the university landscape, it can also result in transition, adaptation, and learning challenges for some students and universities need to attend to this.

Self-Regulated Learning: A Compass for Learning and Teaching in Undergraduate Courses

A promising approach to supporting undergraduates who struggle with learning at university is to promote their engagement in self-regulated learning (SRL). From a learning point of view, SRL refers to intentional, active, and strategic engagement before, during, and after learning activities (Butler et al., 2017; Greene, 2018). This approach to learning involves integrating cognitive and metacognitive

processes in addition to regulating emotional, motivational, behavioural, and contextual elements (Butler & Cartier, 2018; Winne & Hadwin, 1998; Zimmerman, 2002; 2008). From a teaching perspective, promoting SRL refers to empowering learners to strategically navigate learning environments and activities (Butler et al., 2017). Research indicates that SRL is malleable throughout the lifespan and that educators can create opportunities to foster students' development of and engagement in effective forms of learning (Perry et al., 2018; Reeves & Stich, 2011; Zusho, 2017). As a learning and teaching framework, SRL can help university students to meet university learning expectations, and instructors to support students' deep and effective engagement with content in their discipline-specific courses (Hadwin & Winne, 1996; Steiner 2016).

Promoting SRL at the University Level: Why is it Important?

Learning at university places high demands on undergraduate students to be autonomous learners (Alexander, 2017; Bembenutty, 2011; Hadwin & Winne, 2012; Zusho, 2017). To meet these demands, undergraduates are expected to know who they are as learners, understand what is involved in tasks and how to engage with them, and, importantly, be flexible about their approach to learning (Hadwin & Winne, 2012).

Research has consistently demonstrated that student engagement in SRL is associated with positive outcomes in and beyond school across educational levels (Dörrenbächer & Perels, 2016; Graham & Harris, 2003; Kitsantas et al., 2008; Robbins et al., 2004; Zimmerman & Schunk, 2011). For instance, high-achieving university students tend to rely on strategic learning and draw on their metacognitive skills and knowledge to direct their learning processes (Kitsantas, 2002). Specifically, they engage in productive goal setting and planning, use effective and flexible strategies, monitor their progress, and adjust their goals or strategies (Hadwin & Winne, 2012; Schmitz & Wiese, 2006; Weinstein et al., 2004). Likewise, postsecondary learners who attain a degree tend to have high expectations of themselves, link effort and persistence to goal achievement, and are keen to engage in new and challenging learning opportunities (Millward et al., 2018).

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However, research also indicates many postsecondary learners do not know or do not effectively use SRL skills (Bembenutty, 2011; Butler et al., 2008; Hadwin & Webster, 2013; Steiner, 2016). They may use learning strategies that worked in high school contexts (e.g., memorizing, rereading) but are less effective in higher education (Kitsantas, 2002; Steiner, 2016; Weinstein et al., 2011). They may interpret learning as knowledge possession, good grades, and attainment of a degree and do not focus their learning on processes such as assessing, integrating, or applying information (Butler et al., 2008). Some may show a mismatch between knowing about skills and processes (e.g., goal setting, learning strategies) and using that knowledge effectively (Foerst et al., 2017).

Importantly, many postsecondary learners have never received explicit instruction about how to take a flexible and reflective approach to learning (Hadwin & Winne, 2012). Hence, some undergraduates do not know how to: (a) capitalize on their learning strengths and cope with learning challenges; (b) recruit, refine, and use strategies that will effectively enhance their ability to learn both on their own and socially; (c) create or select environments that support their learning; and/or (d) recognize and take advantage of contextual opportunities to engage in effective forms of learning (Zimmerman, 2002). Therefore, navigating the university context may be challenging for them and they need to acquire these skills as they go through their postsecondary programs (Foerst et al., 2017; Hadwin & Winne, 2012; Pintrich & Zusho, 2007; Wolters & Hoops, 2015; Zusho & Edwards, 2011). These findings suggest that it is important to support the development and enhancement of SRL at the postsecondary level.

Supports for SRL in Postsecondary Settings: What has been done?

Efforts at promoting student learning and study skills within postsecondary settings have included supports provided outside content courses and supports provided within content courses. For example, most higher education institutions have support structures in place, such as tutoring/coaching, study strategies workshops, and learning to learn courses, that focus on developing knowledge and skills associated with SRL (e.g., time management, goal setting, reading strategies). Certainly, these help students cope with academic challenges, navigate learning at university, and improve their academic success and wellbeing (Butler, 1999; Lizzio & Wilson, 2013; Reed et al., 2009; Theobald, 2021; Vogel et

al., 2007; Wolters & Hoops, 2015). However, these academic supports tend to be short in duration (e.g., one-off workshops) and separate from students' coursework (Wolters & Hoops, 2015). Students are expected to transfer the knowledge and skills acquired in these experiences to their course contexts, but research indicates this transfer is hard to achieve (Butler, 2002; Hadwin & Winne, 2012; Hattie et al., 1996; Parker & Boutelle, 2009). Moreover, while some of these learning opportunities are open to all students enrolled in the university, many are targeted to a small number of students who must seek them out (e.g., individuals with specific needs, novice students, students on academic probation) (Hofer & Yu, 2003; Wingate, 2006).

Linking SRL Supports to Coursework. To address these issues, some instructional support models have made a point of explicitly linking SRL to relevant coursework. Some efforts focus on supporting individual or small groups of students to develop strategic approaches to learning over time rather than only boosting their strategy repertoire in, for example, one-off workshops. Butler (1995; 2002; 2003) designed Strategic Content Learning (SCL), a coaching-based model of strategy instruction for postsecondary learners with learning disabilities. Through systematic discussions (e.g., What are you being asked to do here? How is it going?), SCL coaches guide students to strategically approach tasks assigned in their courses, which helps them learn about themselves as learners and build effective personalized strategies in relation to these tasks. Students are part of the solution finding and 'do' the regulation that enables them to navigate different learning tasks and environments.

Other efforts enroll students in semester long courses where explicit instruction and guidance about how to engage in SRL-related processes (e.g., task understanding and monitoring) is paired with completing academic work from concurrent content courses. These courses can accommodate more students. They are typically available to all students, but recommended for new students, students enrolled in traditionally difficult courses, and students at-risk for academic failure. Examples of such courses include: Learning Strategies for University Success (University of Victoria, Canada), Supplemental Instruction Model (Arendale, 1994), and Steiner's (2016) Strategy Project Assignment. These examples will be elaborated in Chapter 2.

These efforts to more explicitly link SRL supports to students' coursework have been effective in enhancing SRL and improving task performance over time (Butler, 2003; Freeman et al., 2012; Hadwin et al., 2019; McGuire, 2006; Steiner, 2016). These supports have helped students to understand and apply the processes of SRL in the context of doing meaningful work by providing students with a schema they can apply to all tasks, as well as inviting learners to "find their own way" to learn. For some learners this has solved the transfer issue (Butler, 2003), but others find it challenging to apply SRL within the typical organizational structures of content courses (e.g., lecture formats, outcome-focused evaluation procedures). Going a step further, research (mainly in Kindergarten to Grade 12, K-12, contexts) indicates that embedding SRL interventions in classrooms may have even more positive outcomes for students (Dignath & Büttner, 2008; Dunlosky et al., 2013; Jansen et al., 2019) and make SRL supports accessible to more students.

Embedding SRL Supports in Courses. Efforts to embed SRL supports in university courses have included research projects and teaching and learning enhancement projects. In the research projects, researchers typically lead the design and implementation of SRL supports in classrooms as part of an intervention study to test the effectiveness of particular strategies or supports (Bednall & Kehoe, 2011; De Corte, 2016, Theobald, 2021). In these projects, instructor involvement in designing and implementing the SRL supports is usually fairly minimal. Hence, SRL supports may not continue, locally, after the projects are over because they may not build instructor or institutional capacity to foster SRL over the long term (Cleary, 2018; De Corte, 2016). Moreover, they may or may not link to the unique needs and characteristics of the context—they may not be ecologically valid, which again may threaten their long-term impact. However, many research projects are theoretically sound and, through dissemination, can contribute knowledge to guide SRL supportive teaching approaches in higher education (Weinstein et al., 2006; Theobald, 2021).

Some university instructors have participated in research-informed projects that build on their expertise and seek to enhance the quality of teaching and learning in postsecondary institutions (Baird et al., 2015; Ferreira et al., 2021; Wieman, 2017). Through these teaching and learning enhancement

projects, instructors have engaged in learning about and implementing "active learning" practices that align with or focus on SRL (Baird et al., 2015; Ferreira et al., 2021; Wieman, 2017). Some of these projects involve collaborations across units in the university that leverage disciplinary and SRL expertise—instructors have had access to SRL expertise (e.g., a researcher who studies SRL, an SRL pedagogical coach) but also offered their expertise in designing, implementing, and evaluating the SRL supports in their courses (Baird et al., 2015; 2020; Ferreira et al., 2021). Teaching and learning enhancement projects are theoretically and contextually sound and offer structures (e.g., time, space, ongoing support, collaboration) that build local capacity at institutions to enhance teaching and learning. In addition, these efforts often have a research or program evaluation component, which can lead to the sharing of "what's learned" more broadly. These projects can inform efforts to bring context-sensitive SRL supports to undergraduate courses in a sustainable manner.

Overall, efforts to embed learning supports (explicitly or implicitly focused on SRL) in content courses have made supports accessible to more students, which has resulted in positive academic outcomes for them (Baird et al., 2015; 2020; Bednall & Kehoe, 2011; De Corte, 2016; Ferreira et al., 2021; Freeman et al., 2014). Further research is necessary to find sustainable and flexible ways to bring SRL supports to content courses. Teaching and learning enhancement projects, which could combine research and practice components, hold promise for accomplishing this goal.

What Needs to Happen at Universities to Advance SRL Teaching and Learning?

Postsecondary learning contexts present some barriers to innovating teaching and learning at universities (e.g., Freeman et al., 2014; Marincovich, 2007; Wieman, 2017). Typically, in many large research-intensive universities, undergraduates are expected to know how to learn. Particularly in lower-level courses, class sizes are usually large, content is delivered through lecture formats, and instructors do not get to know the diverse strengths and needs of their students, let alone respond to them. In addition, undergraduate courses are confined to a short timeline (e.g., 13-week terms) and heavily focused on covering content, often in ways that encourage students to use surface strategies to memorize facts and recipe-like procedures to solve problems (Ake-Little et al., 2020; Hadwin & Winne, 2012; Wieman,

2017). These tactics may prove useful for passing exams, but rarely lead to deep learning required for acquiring disciplinary or adaptive expertise (Weinstein et al., 2011). Instructors are disciplinary experts who may not have learner-centred pedagogical training and, if they do, their working context (e.g., department structure /institutional culture) may not support such approaches to teaching for the reasons outlined above (Bathgate et al., 2019; Weller, 2019).

Getting university instructors involved in reframing their teaching contexts and practice to allow for SRL supports to exist could enhance teaching and learning in undergraduate courses (Hoops et al., 2016; Pintrich & Zusho, 2007; Weinstein et al., 2006). To this end, classroom-based research examining supports for SRL in K-12 educational settings may be useful. For example, Perry and colleagues (Perry, 1998; 2013; Perry et al., 2018) have described SRL supports in elementary classrooms, including structural and autonomy supports, scaffolding student learning, and creating a community of learners. Informing university instructors about SRL supportive principles and practices as well as offering them support and opportunities to translate these to their university teaching practice, may empower instructors to change undergraduate teaching and learning.

Similarly, research in K-12 settings has engaged educators in collaborative and individual inquiry in on-going, research-informed professional development and these efforts have resulted in sustainable and meaningful changes to instructional practice (Butler & Schnellert, 2020; Foster, 2014; Perry et al., 2015; Timperley et al., 2014). Using these approaches to work with university instructors could be a productive route to addressing the need to provide dedicated space and time for them to learn about SRL principles and practices so they can customize them to their working contexts (Bathgate et al., 2019; Hoops et al., 2016; McKeachie, 2007). Supporting university instructors to mobilize SRL theory into their practice while simultaneously learning with and from them about the experience of trying to embed these practices in their courses can advance research and practice about SRL.

Overview of My Study

My study was grounded in situated and social constructivist conceptions of meaning making and contemporary conceptualizations of SRL that consider its dynamic and multi-determined nature (Bergold

& Thomas, 2012; Butler & Cartier, 2018; Perry et al., 2018; Zusho, 2017). With the purpose of enriching teaching and learning concerning SRL in postsecondary settings, my study sought to: (a) document how a group of university instructors included SRL promoting practices in their undergraduate courses as they participated in SRL-informed inquiry about teaching and learning; and (b) probe university instructors' perspectives about supporting SRL in their undergraduate courses.

I used a multiple case study design because I was interested in exploring and describing the instructors' SRL-focused teaching practice (unit of analysis) in-depth and as it occurred in discipline-specific undergraduate courses (Yin, 2018). Moreover, a case-study design enabled me to use a dynamic and recursive research process and collect multiple types of data from different sources over time, as warranted in SRL research (Butler & Cartier, 2018; McCardle & Hadwin, 2015; Winne & Perry, 2000).

With the intention of fostering a reciprocal relationship with participants (Coburn & Penuel, 2016; Penuel et al., 2020), I partnered for ten months with five university instructors who belonged to the Faculty of Science in a large research-oriented university on the west coast of Canada. I invited them to engage in situated collaborative and individual inquiry processes (Halbert & Kaser, 2013; Kaser & Halbert, 2017) to learn about and design SRL teaching practices that addressed what they perceived to be their students' learning needs as the academic term unfolded. This approach to research and professional development has been productive for educators to mobilize theory into practice (Butler & Schnellert, 2020; Cochran-Smith & Lytle, 2009; Perry et al., 2015; Timperley et al., 2014; Yee et al., 2019).

Together, we formed a Community of Inquiry (CoI) to bring to life the collaborative inquiry process. CoIs are thought of as a learning experience in which a group of people collaborate to critically explore a shared topic of interest (Garrison et al., 2000). Our CoI met five times to explore how bringing SRL supports to undergraduate courses could enhance the learning of students. The CoI provided a forum where we shared our expertise with one another, learned and discussed SRL theory and supportive practices, and co-constructed meaning based on the individual instructors' SRL-informed teaching practice. Throughout the study, the instructors also engaged in individual inquiry, which consisted of iterative cycles of planning, enacting, reflecting, and adapting their SRL-informed teaching practice in an

undergraduate course of their choosing. The collaborative and individual inquiry occurred in tandem and informed one another. I assisted the instructors' engagement in the research process by organizing and facilitating our CoI meetings and offering them on-going support (i.e., SRL expertise, resources, brief individual conversations) to design and implement SRL innovations in their courses. I collected records of the instructors' actions and reflections of teaching for SRL (i.e., reflection templates, check-out slips, audio recordings of meetings, and notes), observed how they infused SRL supports in their courses, and interviewed them to understand their experience of teaching for SRL.

Initially my goal was to address two research questions:

1. How did participating instructors infuse opportunities for SRL in their undergraduate courses?

2. How did instructors perceive supporting SRL in their undergraduate courses?

    i. How did instructors perceive the effectiveness of these practices to meet the SRL goals they identified for their students?

    ii. How did instructors perceive these practices made a positive difference in student participation and performance?

    iii. What factors did instructors perceive as affording and/or constraining their efforts to support SRL in their courses?

However, the participatory nature of my research encouraged instructors to express their needs and questions in relation to the study. Conversations in the CoI surfaced a desire on the part of instructors to hear directly from students. The instructors wanted to learn how students experienced their efforts to support SRL. Hence, a third question was added to my study:

3. How did students experience the SRL opportunities offered in their courses?

To address this question, I interviewed a small number of students enrolled in participating instructors' courses at the end of data collection. Although evidence from these interviews did not inform instructors' cycles of inquiry in this study, instructors could use it to inform their SRL-focused teaching in

the future. As well, answers to this question enriched my interpretations of the self-report and observational data that I used to address my second research question.

In addition, even though inquiry was at the core of the research design and process, I did not initially plan to "study" how the instructors' participation in a group structure (CoI) and personal inquiry supported their understanding and use of SRL teaching and learning frameworks. Nevertheless, as the study unfolded, it became evident that both the collaborative and individual inquiry were essential to the instructors' framing of teaching and learning through an SRL lens. Therefore, I added a fourth and final research question:

4. What roles did a Community of Inquiry (CoI), as a collaborative structure, and individual inquiry, as a process, play in helping this group of instructors translate and mobilize SRL research in their practice?

In sum, in my dissertation study I examined how, as a group of university instructors engaged in SRL-informed inquiry, they infused their teaching with SRL supports to help the students enrolled in their undergraduate courses develop deliberate and adaptive approaches to learning. In addition, my study examined the instructors' perceptions about bringing SRL supports to undergraduate courses and how a few students enrolled in those courses experienced these SRL supports. Lastly, my study explored whether and how collaborative and individual inquiry approaches to professional learning helped the instructors advance their practice.

Dissertation Overview

In this chapter, I positioned SRL as a teaching and learning framework with potential to address many of the challenges identified in research about teaching and learning at university. I also presented existing supports for SRL in postsecondary settings and considered their strengths and some challenges to warrant the approach used in my study. In Chapter 2, I provide an in-depth description of SRL theory and SRL supportive practices as sensitizing lenses that shaped my study. I also describe efforts to support SRL in higher education to anchor my study. In Chapter 3, I describe the context for my study and position myself in relation to the topic, context, and participants. I outline the research design and

processes used in my study. In Chapter 4, I describe each instructor's SRL-focused teaching journey prior to addressing my research questions in Chapters, 5, 6, and 7. In the final chapter, I link my research findings to the literature, consider contributions to theory and research, implications for practice in postsecondary settings, and propose directions for future research.

Chapter Two: Teaching and Learning for Self-Regulated Learning in Postsecondary Settings

This chapter is divided into three sections. In the first section, I define SRL, focusing on situated models of SRL and reviewing evidence about SRL's relevance in postsecondary learning. In the second section, I describe efforts to support SRL in higher education, focusing particularly on course-related supports. In the last section, I review evidence concerning effective teaching practices in postsecondary settings and follow this evidence with principles and practices emerging in classroom-based research about fostering SRL in the K-12 system.

Self-Regulated Learning

A definition of self-regulation proposes people manage their thoughts, motivation, feelings, and actions to attain personal goals and respond to environmental demands (Boekaerts, 2011; Schunk & Greene, 2018; Zimmerman, 2008). In the context of learning, self-regulation manifests in proactive and strategic approaches to completing academic tasks and activities (Greene, 2018). Zimmerman also defined SRL as the "degree to which students are metacognitively, motivationally, and behaviourally active participants in their own learning process" (1989, p. 329) and emphasized how SRL supports independent and social forms of learning (2002; 2008).

Models of SRL tend to be cyclical and emphasize that SRL is anchored in recursive stages of planning, enacting, monitoring, and adjusting (Figure 2.1). These models suggest SRL is rooted in recursive self-oriented feedback about the effectiveness of learning (Butler & Cartier, 2018; Pintrich, 2004; Winne & Hadwin, 1998; Zimmerman, 2008; Zusho, 2017). Over time, SRL scholars have foregrounded the social and situated aspects of SRL (Butler & Cartier, 2004; Hadwin et al., 2018; Järvenoja et al., 2015; McCaslin & Good, 1996), emphasizing individuals do not regulate in a social, cultural or historical vacuum. Decisions they make about how to regulate are influenced by past experiences, personal beliefs and self-perceptions, but also respond to the settings and circumstances in which they find themselves (Butler & Cartier, 2018; Hadwin et al., 2018; Zusho, 2017).

Figure 2.1

Self-Regulated Learning
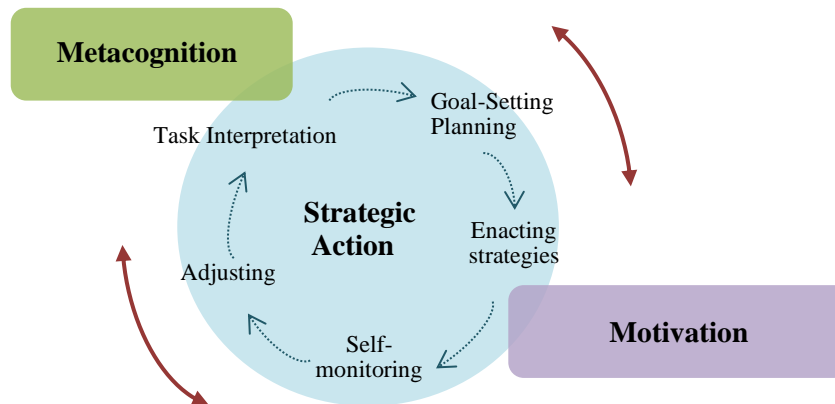
Situated Models of SRL

       Butler and Cartier (2018) propose a situated model of SRL. According to their model, SRL emerges from complex interactions between what students bring to learning environments (e.g., prior knowledge, metacognitive knowledge, identities, beliefs, interests, experiences, work habits, strengths, challenges) and opportunities provided in contexts where they are learning (e.g., opportunities provided through tasks, instructional supports, and collaborations with peers). Moreover, their model emphasizes how students' engagement in SRL is mediated through their continuous appraising of a situation (e.g., What am I being asked to do? What could go wrong? How should I approach this?). These appraisals inform and shape subsequent approaches to learning. Finally, the cycle of strategic action is at the centre of their situated model, representing iterative and dynamic cycles of planning, enacting, reflecting, and adjusting characteristic of other models of SRL. Their model emphasizes how students engage in strategic action cycles on their own and with others.

       My research was designed with Butler and Cartier's model in mind because it foregrounds the interaction between learners and contexts. In addition, Zusho's *Integrative Model of Learning in the College Classroom* (Zusho, 2017) enabled me to flesh out the interaction between individual and contextual aspects as antecedents of learning outcomes in higher education contexts. Of relevance for this

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study, contextual aspects related to academic disciplines, curricula, and institutional supports and constraints influence student approaches to learning by shaping contextual and personal factors that have a direct influence on learning. For example, academic disciplines and programs shape the design of academic tasks (e.g., structure, level of difficulty, requirements) and influence teaching practices (e.g., didactic versus interactive and autonomy supportive), which in turn have an effect on students' learning. Embedded in these situated models of SRL is the notion that SRL is malleable and educators can create opportunities for students to regulate learning in classrooms (Perry, 2013; Perry et al., 2018; Reeve, 2006; Stefanou et al., 2004). Research focused on characterizing SRL supportive classrooms (in the K-12 educational system) emphasizes the relevance of tasks/activities, instructional practices, and interpersonal interactions in fostering SRL (Perry, 2013; Perry et al., 2018; Perry & Rahim, 2011).

Social and situated models of SRL have introduced the terms co-regulation and shared regulation to describe how students develop and engage in regulating learning in interactive/collaborative learning contexts, such as classrooms (Hadwin et al., 2018). Hadwin and colleagues (2018) suggest that co-regulation implies the temporary mediation of regulating learning in transition to self-regulation. Co-regulation occurs when learners recognize conditions, supports, and prompts for regulation in interaction with others (i.e., teachers, peers), tools, tasks, and the environment (sociocultural context). These transient supports can be affording or constraining to productive regulation. Affording supports (e.g., guiding prompts, formative feedback) encourage learners' engagement in strategic action, which is useful when approaching new and/or challenging learning activities. As learners recognize and use supports, they feel better equipped to navigate activities and contexts and to take control of their learning. Supports can thwart SRL when they do not support learners to take over the processes of learning.

Shared regulation takes place during interpersonal interactions and collaborative learning efforts (Järvelä & Hadwin, 2013). It is reflected in ways groups negotiate their joint engagement in cycles of strategic action to co-construct meaning and learn together (Hadwin et al., 2018). It describes collectively regulated activity where learners who are working together have a common goal, co-interpret tasks, co-plan ways to approach them and, as a group, monitor that their progress matches their goals and refine

their actions as needed (Hadwin et al., 2018). Shared regulation emerges from and occurs along side self and co-regulation (Miller & Hadwin, 2015).

SRL Dimensions

Most theoretical perspectives agree that SRL is multi-componential with three main interrelated dimensions: (a) metacognition, (b) motivation, and (c) strategic action.

Metacognition. A first component of SRL reflects awareness about oneself in relation to learning activities and the way one both understands and deals with learning and learning activities (Hadwin & Winne, 2012). Metacognitive knowledge reflects self-awareness of strengths and challenges in relation to tasks and their requirements, and knowledge of strategies for learning that leverage strengths and compensate for challenges one brings to academic tasks. Further, it implies knowing how to recruit strategies to meet task demands and address challenges as well as knowing when and why to use specific learning strategies (conditional knowledge; Schraw & Moshman, 1995). Learners can develop their metacognitive knowledge and skills to address or compensate for challenges in learning (Cleary, 2015; Zimmerman, 2008).

Motivation. A second dimension of SRL refers to learners' willingness to initiate, invest, and maintain behaviour to achieve a goal in learning activities. Motivation anchors learners' engagement in learning activities and shapes their interaction with others (i.e., teachers, peers) and their perception of outcomes (Butler & Cartier, 2018; Wolters & Hoops, 2015; Zimmerman, 2008). Self-regulating learners have a sense of agency over their learning— they perceive they can control their learning processes and outcomes by being intentional, self-reflective, and adaptive about their engagement in learning activities (Zimmerman et al., 2015). Students' beliefs about themselves as learners and in relation to tasks are essential to feeling in control of learning (Zimmerman & Schunk, 2007; Zimmerman et al., 2017). Self-efficacy beliefs, defined as learners' judgments about their likelihood of success in meeting a goal or completing a particular task determine learners' dispositions to engage in learning tasks (Zimmerman & Schunk, 2007). These judgments are influenced by personal perceptions of skills, internal and external expectations for success, past experiences with similar tasks, and the context (Bandura, 1997). For

instance, learners' implicit beliefs about their abilities influence how they approach learning (Dweck, 2010). Those who have a growth mindset believe abilities are malleable and, as such, will pursue challenging activities, invest effort in learning and problem solving, and view errors as learning opportunities. On the other hand, learners with a fixed mindset believe their overall abilities are static and may question the utility of expending effort to regulate learning in a situation where they judge low likelihood of success (Dweck, 2010). Learners' perceptions about the value of a task define their interest in and relevance they attribute to it, which also determines the effort (e.g., persistence, cognitive processing) they are willing to invest in approaching the activity (Eccles & Wigfield, 2002). Beliefs, values, and expectations are shaped by the environment in which learners are immersed and influence the ways in which they engage with learning activities (Liem & McInerney, 2018; Reeve et al., 2007; Stefanou et al., 2004).

Strategic Action. A third and central component in SRL is strategic action. It entails iterative and dynamic goal-directed activity—processes learners engage in before, during and after learning tasks, including interpreting tasks, setting personal goals, planning, enacting strategies, self-monitoring/assessing progress, and making necessary adjustments for attaining goals (Butler & Cartier, 2018). Engagement in the processes within strategic action cycles is dynamic: self-regulating learners move back and forth across processes to inform and drive their effective engagement in learning activities (Ning & Downing, 2015). Butler and Cartier (2018) emphasize that learners can engage in cycles of strategic action on their own and with others.

Interpreting tasks and expectations implies developing accurate and complete task perceptions. Learners interpret task characteristics and expectations based on prior experiences and motivational beliefs about similar tasks, constraints and resources in place, as well as their self- and subject-related knowledge (Hadwin & Winne, 2012; Pintrich, 2004). Learners also rely on task features to interpret them. These include explicit features (e.g., task requirements, evaluation criteria, and instructions); implicit features (e.g., task purpose, links between tasks and other course components, task resources); and socio-contextual task features which are embedded in the broader context of a course or specific-content

domain (e.g., disciplinary traditions) (Hadwin & Winne, 2012). Research shows that task understanding and interpretation are fundamental to engaging in effective forms of learning (Hadwin & Winne, 2012; Oshige, 2009). Learners who do not perceive tasks accurately will set unfitting goals, choose and use ineffective strategies, which often leads to a mismatch between task purposes and teacher expectations and what students produce (Butler, 1995; 1998b; 2003; Hadwin & Winne, 2012).

When *setting personal goals,* self-regulating learners set high-quality goals and standards in relation to their learning in the context of a given activity. Setting goals is an agentic process so learners may also set motivational, emotional, and cognitive goals for a given task, which are not necessarily parallel to goals set by others (e.g., educators) (Hadwin & Winne, 2012; Hadwin et al., 2018). Self-perceptions of competence, personal prior experience/performance with similar tasks, and accurate task understanding influence learners' quality of and commitment to goals, as well as the learning strategies they recruit to attain them (Butler, 2002). When learners set a goal for learning, they generate a judgment about whether they can meet the goal. This judgement anchors further processes in the cycle of strategic action such as planning, enacting, and self-monitoring (Hadwin & Winne, 2012; Winne & Hadwin, 1998).

Planning is intimately tied to task understanding and goal setting as learners make decisions about which resources, materials, and strategies they will select and use (e.g., information processing, self-testing, help-seeking, chunking long-term projects into mini-tasks) in order to achieve their personal learning in a given task (Butler et al., 2017). Once learners have devised a plan of action, they implement or *enact the planned strategies* to move towards the attainment of their goals. As learners implement their plans, they *self-monitor and self-assess* their understanding, motivation/affect, effort, actions, and progress in relation to goals (Pintrich, 2004).

Hadwin and Winne (2012) suggest that regulatory action is activated when learners find inconsistencies between their goals and performance through their continued engagement in monitoring processes. This monitoring also leads to changes in the way learners approach future studying tasks, that is, adaptations to metacognition and motivational/affective reactions to tasks and outcomes (Winne &

Hadwin, 1998; Pintrich, 2004). Therefore, setting effective goals and monitoring the match between performance and expectations, supports performance outcomes and strategic adaptation. The cycle continues with learners *making necessary adjustments* in response to internal feedback (generated through self-monitoring) and external feedback they receive from the context (Butler & Cartier, 2018), which may prompt them back to planning, enacting, and reflecting.

SRL and Postsecondary Learners

Evidence suggests that SRL is associated with postsecondary learners' academic achievement. Specifically, research indicates university high achievers are motivated for learning (Gandomkar et al., 2016; Millward et al., 2018; Pintrich & Zusho, 2007; Wolters & Hussain, 2015), ground their learning processes in metacognitive knowledge and skills, and strategically tailor the strategies they use to meet learning goals and requirements (Kitsantas, 2002; Kitsantas et al., 2008; Pizzimenti & Axelson, 2015; Robbins et al., 2004; Zusho et al., 2003).

Successful university students display metacognitive awareness in strategic approaches to tasks and learning challenges. They are goal-oriented, know about the academic environment in which their learning occurs (e.g., performance criteria, teacher expectations, task purposes), and devise plans, try and adapt strategies (e.g., help-seeking, effective time management, self-monitoring) to attain learning goals (Hensley et al., 2016; Pintrich & Zusho, 2007; Stanton et al., 2021; Tuckman, 2003; Weinstein et al., 2004; Zusho, 2017). Research has linked university students' use of deep learning strategies (e.g., elaboration and critical thinking) to higher final grades in subject specific courses (Ning & Downing, 2015; Pizzimenti & Axelson, 2015; Winne & Hadwin, 1998). Self-regulating university learners also display adaptive and positive motivational beliefs (Pintrich & Zusho, 2007; Wolters & Hoops, 2015). This disposition means they are willing to put in effort and persist through challenges because they find purpose in learning or engaging in a learning activity. In addition, they have a constructive view of failure, they hold positive self-beliefs in relation to learning, and want to progress to attain meaningful goals (Gandomkar et al., 2016; Millward et al., 2018; Wolters & Hoops, 2015).

However, many postsecondary learners do not effectively use SRL skills (Bembenutty, 2011; Hadwin & Webster, 2013; Nandagopal & Ericsson, 2012; Ning & Downing, 2015; Steiner, 2016). Regarding motivation for learning, research suggests that university students with low academic achievement hold negative self-efficacy beliefs for learning and procrastinate (Hensley et al., 2016; Pintrich & Zusho, 2007). In addition, less successful undergraduates lose interest in learning and attribute low achievement to factors that are out of their control, such as ineffective instruction or content difficulty or irrelevance (Gandomkar et al., 2016; Heikkila & Lonka, 2006; Nilson, 2013).

Research also suggests some undergraduate students struggle to engage strategically with learning tasks. For example, they might rely on partial information to interpret tasks (e.g., explicit task features) or fail to recognize difficulties in task understanding (Hadwin & Winne, 2012; Oshige, 2009). They may set vague goals (i.e., do my homework), which are ineffective to activate their engagement in other regulatory processes like choosing strategies and monitoring (McCardle et al., 2017). Hensley et al.'s (2016) study of college students' self-reported attitudes about time management concluded that students on academic probation reported spending significantly less time on goal-setting and planning than their peers in good academic standing. In relation to strategy recruitment and use, low-performing undergraduates often recruit ineffective strategies (e.g., rereading or memorizing) and do not engage deeply with content or cope well with challenges encountered in the learning process (Kitsantas, 2002; Steiner, 2016; Weinstein et al., 2011). Likewise, research suggests low-achieving students use surface self-monitoring strategies either because: they do not understand how self-monitoring is useful in strategic learning (Zimmerman, 1989); self-monitoring interferes with information processing to perform learning tasks (Winne, 1995); or they choose to avoid the affective effects of logging learning failures (i.e., in reflection activities) (Dörrenbächer & Perels, 2016; Fabriz et al., 2014). Altogether, these findings highlight the relevance of supporting undergraduate students to develop and engage in productive forms of SRL.

Supports for SRL in Postsecondary Settings

Higher education institutions offer students a range of academic supports to help them navigate learning in this context and improve their academic success and wellbeing (Wolters & Hoops, 2015). Many of these supports align with aspects of SRL (implicitly or explicitly). Most of these supports occur outside of content courses but, increasingly, there are efforts to align supports with content courses and embed support in content courses (Figure 2.2). Embedding supports in content courses has the potential to meet the learning needs of large numbers of students. Below, I offer a brief review of research concerning content/course independent supports for SRL in higher education contexts. Then, given the focus of my study, I provide a more elaborated description of supports specifically designed to promote SRL in relation to university coursework.

Figure 2.2

SRL Supports in Postsecondary Settings
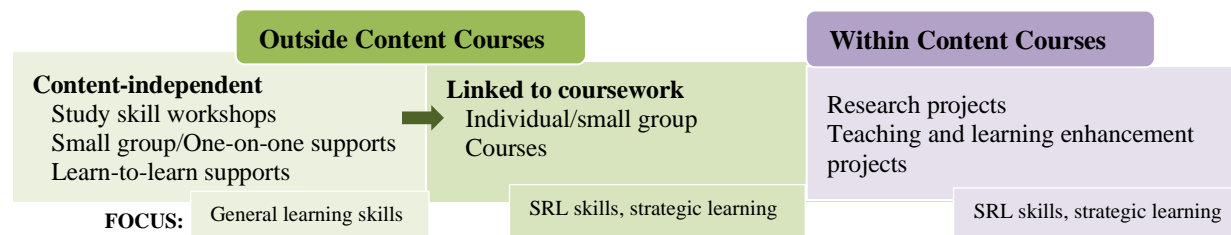
SRL Supports Outside of Content Courses

Content-Independent Supports. Approaches labeled as study skill workshops, small group/one-on-one supports, and learn-to-learn supports seek to develop and/or enrich general knowledge and skills associated with SRL (Wolters & Hoops, 2015). These supports have helped university students who are struggling in their learning and informed efforts to foster SRL in content related work. Thus, it is relevant to briefly describe them.

Study skill workshops are typically short-term (perhaps one-time), widely available supports that are delivered in various formats (i.e., print, face-to-face, online). Study skill workshops are based on the idea that learning strategies are pivotal to navigating university learning and that students who obtain higher grades use a wide variety of learning strategies (Tuckman & Kennedy, 2011; Weinstein et al.,

2011; Wingate, 2006). Hence, these workshops are designed to enrich students' strategy repertoire (e.g., knowledge of strategies for time management, critical thinking, exam preparation, presenting, note taking, group work, using technology for academic success), so they can meet learning expectations and cope with academic challenges. One-time strategy and study skill workshops are effective at enriching students' knowledge of general skills and resources, giving students some sense of control over learning, and reducing anxiety and stress related to schoolwork (Reed et al., 2009; Wingate, 2006).

Small group/One-on-one supports (e.g., tutoring and coaching) are typically offered through units such as learning support centres and academic advising units and are more personalized than the workshops described above (Wolters & Hoops, 2015). In these contexts, peer mentors, faculty members, or support workers create a safe space and offer opportunities for learners to be active participants in developing their support plan. Students may engage in individual or small group support sessions on a regular basis. In these contexts, they receive guidance through prompts (e.g., dialogue, questions, feedback) and practical activities to improve domain-relevant knowledge (but typically unrelated to specific coursework) and general study skills (Topping, 1996); are invited to develop a plan of action (e.g., Co-active Coaching Model; Maitland, 2008); learn to use or adapt strategies to cope with academic challenges; and are informed about other available resources (Parker & Boutelle, 2009). Coaching and tutoring supports are linked to student increased academic performance and engagement, retention to graduation, and decreased psycho-social issues (Grillo & Leist, 2013; Topping, 1996; Vogel et al., 2007). Research indicates that coaching and tutoring supports that position students as active partners in the process of learning how to navigate academic life can nurture self-determination, metacognitive knowledge and skills, goal-oriented action, and emotion regulation (Parker & Boutelle, 2009).

Learn-to-learn supports take a holistic view of learners and seek to ensure student academic success and wellbeing by focusing on prerequisite skills, motivation and emotional aspects, study and learning skills, and self-regulation (Dembo & Seli, 2004; Freeman et al., 2012). They assume that promoting academic self-management and addressing psycho-social factors will foster resourcefulness skills, academic self-efficacy, internal locus of control and, ultimately, academic success (Reed et al.,

2009). Compared to other content-independent supports, learn-to-learn supports are usually longer in duration (e.g., 10 sessions, 12 weeks), may be for credit, and provide the space and time for students to practice the acquired skills (e.g., navigating university tasks like researching, reading and writing, time management) (Wolters & Hoops, 2015). In learn-to learn courses, students are encouraged to develop an active/adaptive approach to learning irrespective of the area of study and apply a general framework to all learning (Dörrenbächer & Perels, 2016; Hensley et al., 2016; Hofer & Yu, 2003; Reeves & Stitch, 2011; Wolters & Hoops, 2015). Some learn-to-learn supports are reactive, helping students to recover from academic failure (Lizzio & Wilson, 2013). Others are proactive, targeting students transitioning from secondary to postsecondary settings to set them up for success throughout their university degree (Hoops et al., 2016; Kitsantas et al., 2015; Tuckman & Kennedy, 2011; Weinstein et al., 2004). These comprehensive, but generally content-independent supports have been linked to better transition and retention outcomes, increased academic performance, engagement and persistence, academic skills and beliefs about learning both in the general student population and in students with diverse learning needs (Hensley et al., 2016; Hofer & Yu, 2003; Kitsantas et al., 2015; Lizzio & Wilson, 2013; Theobald, 2021; Weinstein et al., 2004).

Despite the effectiveness of content-independent supports in training general strategies and skills and in improving students' academic success and wellbeing, two challenges have been identified in relation to students SRL: transfer and accessibility. Regarding the issue of transfer, students are expected to apply the knowledge they acquire in these experiences to their coursework. However, many students fail to recognize when, where and how to apply strategies learned in one context to another, struggle to adapt potentially useful skills and strategies to new settings and situations, or to personalize strategies to suit their strengths and/or challenges (Butler, 2002; Dembo & Seli, 2004; Freeman et al., 2012; Hadwin & Winne, 2012; Hattie et al.,1996; Parker & Boutelle, 2009; Wingate, 2006). This phenomenon might occur due to the fact that these learners do not know more appropriate strategies, believe they cannot change, or perhaps because they do not know how to adapt the strategies they do know to suit different learning situations (Dembo & Seli, 2004). General learning skill supports are useful to meet students where they

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are at in relation to their strategy background knowledge (Weinstein et al., 2011), but presume strategies are universally effective for all students regardless of the setting or situation. Moreover, content-independent supports may encourage surface level engagements where students simply learn strategies rather than learning to be strategic (Butler, 2002; Hadwin & Winne, 2012; Wolters & Hoops, 2015).

In relation to the second challenge (i.e., accessibility), while some content-independent academic supports are accessible to all enrolled students (e.g., study skill workshops, learn-to-learn courses), they commonly target individuals with specific needs, such as students at risk for academic failure, students with self-identified disabilities, and novice students (Wolters & Hoops, 2015). Moreover, these supports are typically not well advertised, so students must proactively seek them out. Research indicates high achieving postsecondary students most frequently access academic supports while those students who need these supports the most are the least likely to access them (Dembo & Seli, 2004; Lizzio & Wilson, 2013). Additionally, students who struggle often consider these supports as a means to an end and will only seek them out when they have pressing academic needs (e.g., to boost grades, finish assignments) rather than as an opportunity to learn how to learn more effectively (Dembo & Seli, 2004; Lizzio & Wilson, 2013; Reed et al., 2009; Wingate, 2006).

Linking SRL Supports to Coursework. To address these challenges, some instructional support models pair explicit instruction on SRL-related processes with completing regular academic work (Wolters & Hoops, 2015). In some of these models, supports are offered to individuals or small groups of students whereas others are offered in whole class situations (e.g., SRL supportive courses).

Individual/Small-Group SRL Supports. Butler's (1995; 1998b; 2002; 2003) *Strategic Content Learning (SCL)* is an empirically validated coaching intervention grounded in SRL theory. It promotes strategic learning, metacognitive knowledge, and motivational beliefs through a problem-solving approach. In SCL, students are guided to engage in cycles of strategic action in relation to a meaningful academic task selected by them. Through interactive, explicit, and systematic discussions about strategic processing, coaches scaffold learners to analyze task demands; set goals and performance criteria; generate and use strategies (e.g., make marginal notes or comments instead of highlighting); monitor their

progress; and adapt their goals and/or strategies if needed. Over time, learners develop their own strategic approaches across a sequence of valued tasks (e.g., reading and writing strategies that relate directly to their coursework). SCL does not involve the direct instruction of predefined strategies but rather emphasizes co-constructing/personalizing strategies based on learners needs and experiences (Butler, 2002). Coaches offer sophisticated forms of scaffolding by observing and questioning to help students complete their learning activities effectively and reflect upon their SRL processes afterward (e.g., what worked well and what might work better in the future?). Through their involvement in SCL, students develop a meta-script for thinking about SRL in relation to specific learning tasks and contexts.

Butler (1998b; Butler et al., 1997; Butler, Elaschuk, Poole, Novak et al., 2000) studied the effectiveness of SCL for improving learning and SRL with more than 100 students (case studies) having learning difficulties in postsecondary settings. Across these studies, SCL was delivered following the three service delivery models used in higher education institutions: (a) individual instruction given by specialists (Butler, 1992; 1993; 1995; 1998a; 1998b; Butler, Elaschuk, & Poole, 2000); (b) peer-tutoring (Butler et al., 1997); and (c) small-group discussions (Butler, Elaschuk, Poole, Novak et al., 2000). Butler has also described an adaptation of SCL to whole-class instruction (2002), which was tried in a secondary setting (Butler et al., 2001). SCL has proven helpful in addressing the transfer issue, as well as for enhancing students' metacognitive knowledge (e.g., awareness of strengths and challenges in relation to learning and specific task demands), sense of control over their learning (e.g., ownership of strategies), and task performance both over time and outside of the intervention sessions (Butler, 2003; Butler, Elaschuk, Poole, Novak et al., 2000; Freeman et al., 2012). In university settings, SCL is commonly used as a coaching model for students self-identified as having a disability (physical, mental, health and/or learning related).

SRL Supportive Courses. Building on the strengths of contextualized strategic instruction, coaching, and learn-to learn supports, SRL supportive courses are structured as semester-long courses that can reach large groups of students. Examples include the Supplemental Instruction Model (Arendale,

1994), Strategy Project Assignment (Steiner, 2016), and Learning Strategies for University Success delivered at the University of Victoria, Canada (McCardle & Hadwin, 2015; McCardle et al., 2017).

The *supplemental instruction (SI) model* is designed as an early-intervention learning assistance model based on collaborative learning that targets students from traditionally difficult and large courses that have high failure rates (Arendale, 1994; Dembo & Seli, 2004). This model supports students learning of the difficult course content by cultivating relevant learning and study strategies. SI sessions are offered outside of the classroom as an accompaniment to the difficult courses. The supports last throughout the term, with particular intensity devoted to the first six weeks before mid-term exams. In SI sessions, peer-mentors coach small groups of students through collaborative activities (e.g., problem-solving) and reflective learning experiences, integrating course content review with strategy practice (McGuire, 2006). Research linked SI to students' improved learning performance (Martin & Arendale, 1990; Ogden et al., 2003), self-efficacy and internal locus of control (Visor et al., 1992), increased graduation rates (Grillo & Leist, 2013; Ogden et al., 2003,), as well as improved academic performance and leadership skills for SI mentors (McGuire, 2006). However, McGuire (2006) summarized some challenges faced by institutions that have used this model: (a) maintaining students' commitment to attending SI sessions regularly; (b) implementing it successfully with students with diverse learning needs; and (c) getting faculty to buy into the model and advocate for it. Some of these challenges could be addressed by supporting course instructors to create opportunities for their students to integrate the learned strategies in their course activities.

Using a different focus, Steiner (2016) developed an instructional method called the *Strategy Project Assignment*. As part of a success learn-to-learn course for first-year college students, the strategy project assignment offers students explicit instruction about strategies (e.g., active reading and note-taking, time management, goal setting, reflection, and effective interaction with instructors) and, through the use of modeling and discussions, students learn why these strategies work. Students then identify a test in a concurrent course they are taking and apply strategies they are learning in the Strategy Project Assignment to prepare for it. This assignment is a multi-step project that provides students with an

opportunity to not only practice the SRL strategies they have learned but also to reflect on their learning process in relation to their exam preparation. To start the project, students contact their content-course instructors to get a clearer understanding of the task they are focusing on. Then, students engage in planning, enacting strategies, and reflecting about their process.

Steiner (2016) analyzed students' written reflections about their engagement with the *Strategy Project* to understand the impact this assignment had on them. She found students valued the assignment—it helped them learn about themselves as learners, enhance their study habits, develop positive self-beliefs, and supported their transition from high school to college. From students' reflections, Steiner developed clearer assignment success criteria to support content-course instructors' engagement in the project and facilitate students' progress. She recommended this assignment be embedded within subject-specific curricula and tailored to specific learning needs to contextualize SRL supports and enhance students' academic success.

The Technology Integration and Evaluation (TIE) Lab at the University of Victoria (Canada) delivers a one-term (12 weeks) success-for-all course, *Learning Strategies for University Success*, to promote not only learners' academic success at university, but also the development and practice of SRL (McCardle et al., 2017). This elective course is grounded in SRL theory and research (Hadwin & Winne, 2012). It is open to all students at the institution but is highly recommended for first year students and those at-risk for academic failure (e.g., students on academic probation). Students enrolled in the course are required to attend weekly large group lectures and small group applied lab sessions, where they learn to examine their own learning process, try new strategies for learning, and use technology for course work and group projects. Students learn theory about SRL processes (i.e., task understanding, goal setting and planning, strategy use, monitoring and adapting) and are offered guided opportunities to master the self-regulation skills they are learning in the course, as well as how to apply them to their regular academic work in concurrent content courses (McCardle & Hadwin, 2015). Throughout the course, students engage in individual and collaborative recursive cycles of strategic action, thereby enhancing their metacognitive skills and knowledge. An important component of the course is the use of technology-based instructional

tools and learning activities (e.g., strategy library, Hadwin et al., 2007; weekly planning and reflection notes, Hadwin et al., 2010a; 2010b; goal-setting tools, Hadwin et al., 2012).

Research conducted in the context of this course (Webster et al., 2010; Hadwin et al., 2019), has demonstrated the course is effective for promoting student development/enhancement of SRL and use of self-regulatory processes to approach academic tasks, which improves the quality of learning. Webster et al. (2010) examined changes in students (n=43) goal stetting over a term. As part of the course, students set goals for tasks assigned in their concurrent courses and reflected on goal attainment. An analysis of goal quality (i.e., goals that lead to productive monitoring and adapting), self-efficacy, and perceptions of goal attainment showed improvements over the academic term. Studies (Davis et al., 2018; Hadwin & Webster, 2013; Hadwin et al., 2018, April) that examined the diary method used in the course demonstrated this tool was useful to improve students' metacognitive awareness (e.g., it prompted students to identify challenges they face during studying and reflect on the strategies they use to respond to them, Hadwin et al., 2018, April). Other research supports the combination of explicit training on SRL-related processes and skills with a reflective component on learning like diaries or weekly logs to foster SRL (Dörrenbächer & Perels, 2016; Fabriz et al., 2014; Hofer & Yu, 2003; Perels et al., 2005; Schmitz, et al., 2011; Theobald, 2021). Embedding instructional tools and learning activities within content courses to support students to deepen their understanding about themselves as learners in relation to discipline-related tasks can enhance their approaches to learning. Also, these practices could inform teaching practice.

Overall, the research supports efforts to explicitly link SRL to students' coursework. It seems these approaches help students to develop a schema to approach different tasks adaptively and figure out what works for them as learners (Butler, 2003; Miller & Hadwin, 2015; Freeman et al., 2012; Steiner, 2016; Theobald, 2021). These supports might be enough for some students to transfer SRL skills across contexts, but others might find it more challenging, especially if their content courses do not prompt SRL approaches to learning. Therefore, bringing SRL supports to university classrooms may have even more

positive outcomes for students (Dunlosky et al., 2013; Hadwin & Winne, 2012; Jansen et al., 2019; Wingate, 2006) and make SRL supports accessible to more students.

SRL Supports Within Content Courses. Examples of explicit support for SRL within content courses are limited, but some undergraduate students have been exposed to SRL in their content courses through research projects and teaching and learning enhancement projects. Given the focus of my study it is relevant to look at the potential of projects like these to bring sustainable SRL innovations to content courses.

Research Projects. Some researchers design studies of SRL supports and implement them in content courses. These examine the effectiveness of specific strategies/supports for enhancing SRL skills and academic performance (see Theobald, 2021). For example, Bednall and Kehoe (2011) evaluated the effectiveness of different levels of online SRL supports embedded in an ungraded mandatory assignment (web-based self-paced learning module) that accompanied a lesson unit in an introductory psychology course. The researchers conducted four parallel experiments where they randomly assigned students (n=618) to different groups, receiving no prompts (i.e., control group) or prompts that sought to activate different types of self-regulatory strategies as students completed the assignment (i.e., experimental groups). In the first experiment, when students in the experimental group opened the learning module, they landed on a page that informed them about and encouraged them to use broad study strategies (e.g., setting learning goals, activating background knowledge, managing time, checking understanding, summarizing) typically used by self-regulating learners. In each of the other experiments the researchers guided students to use specific strategies (i.e., explanation generation and/or summarization in experiment 2; planning in experiment 3; self-generated and external feedback in experiment 4). Guidance to engage in elaboration, planning, and self-monitoring processes was in the form of questions (e.g., What is my overall learning goal? How will I check that I'm making progress towards my goals?) or prompts (e.g., write an explanation for a concept, check for understanding, feedback). Student content understanding was assessed through an online test.

These researchers found positive effects on student academic performance, particularly when supports prompted students to use broad study tips and engage in planning and elaboration (i.e., self-explanation) processes. This study demonstrated that embedding SRL supports in unsupervised content-related studying sessions can be a productive vehicle for university instructors to both enhance student disciplinary knowledge and engagement in SRL, but the researchers acknowledged further research about how to design these prompts to meet student needs is necessary.

Similarly, De Corte (2016) designed, implemented, and evaluated an instructional intervention to enhance SRL and learning proficiency in novice business economics undergraduates (n=141). The intervention design was grounded on SRL theory and research as well as on principles of effective instruction (i.e., situated knowledge/skills learning, tasks/learning are personally useful, sequence teaching methods and tasks, use various forms of organization and social interaction, accommodate individual differences, stimulate reflection, create opportunities for practice). Students were assigned to one of three groups. The experimental group participated in ten sessions (i.e., two general, eight content-specific) in which students were trained in related cognitive and affective self-regulation skills (i.e., task understanding-self-judging; planning-value; self-checking-coping with emotions; reflecting-attribution). They were also assigned homework (for practice and transfer). There were two control groups, the first one also participated in the ten sessions and was assigned homework but training focused on cognitive skills (e.g., analyzing, structuring, rehearsing); the second control group attended regular content seminars. In the training sessions, tutors (researchers) scaffolded learners through modeling and strategic questioning to stimulate goal-oriented, active, and collaborative learning. In the content-specific sessions, students also engaged with meaningful tasks that were adjusted to their prior knowledge and prompted students to reflect on their learning processes. Students were offered opportunities for practice and support to transfer their learning/SRL to new content domains.

De Corte (2016) measured student's metacognitive knowledge (i.e., using a test) and transfer of skills to untrained courses (i.e., through a self-report questionnaire about their use of skills). He found course takers knew more about the trained self-regulatory skills, used more self-regulatory skills in

targeted courses, were able to successfully transfer the use of these skills to another course, and showed better academic performance than students in the control groups. This study demonstrated that using SRL theory and principles of effective teaching to design learning environments is promising to fostering student SRL and content-specific learning. However, De Corte (2016) acknowledged that the implementation of these instructional innovations requires professional learning opportunities that enable course instructors to learn about teaching principles and practices and mobilize them into their practice.

Research projects that contextualize SRL supports in content courses are theoretically strong and useful for understanding how to design SRL supportive learning environments (Weinstein et al., 2006; Theobald, 2021). Typically, course instructors support these efforts; for example, they offer their classroom/course as a living laboratory. These instructors might observe what happens in the classroom but, unfortunately, they are not usually involved in learning about SRL themselves, or in designing, implementing, or evaluating the SRL supports. Also, in researcher-led projects, SRL supports may or may not link to the unique needs and characteristics of the learning context and students, as they tend to follow the researchers' agendas. Consequently, the instructional transformation potential in these initiatives, at least locally, is low (Drago-Severson & Blum-DeStefano, 2018; Halbert & Kaser, 2021); they rarely lead to sustained and meaningful change in the contexts where they originate. However, to the extent these efforts get published, they advance theory and research and, potentially, become a resource for promoting "best practice" through professional learning initiatives like those described in the next section.

Teaching and Learning Enhancement Projects. In recent decades, institutions and practitioners have increased their attention to the quality of undergraduate teaching and learning to support students' development of adaptive expertise to succeed in and beyond university (Dumont et al., 2010; Entwistle, 2012; Marincovich, 2007). Such efforts are grounded on research showing that guided, active, and experiential learning are essential for students to develop life-long learning skills (Ambrose et al., 2010; Dumont et al., 2012; Wieman, 2017). As a result, different structures have been developed to facilitate faculty to transition from traditional teacher-centred instructional practices (e.g., didactic lecture formats) to learner-centred teaching practices (e.g., Socratic and collaborative activities) (Chasteen &

Code, 2018; Marincovich, 2007; National Research Council, 2012; Stains et al., 2018; Wieman, 2017).

For example, teaching and learning centers are supporting faculties, departments, and instructors to address their teaching needs, and institutions and groups of scholars have developed teaching handbooks and educational resources (e.g., assessment tools, learning goals, educational software). Institutions are investing more resources in teaching training and transformative initiatives (e.g., elaborate and sustained TA training, redesign of undergraduate courses, technology) and spaces for sharing and promoting teaching and learning innovations such as SALTISE (Supporting Active Learning & Technological Innovation in Studies of Education) and ASCN (Accelerating Systemic Change Network) have been created (Marincovich, 2007).

Increasingly, instructors are taking advantage of these structures by getting involved in learning about and implementing student-centred teaching practices in their content courses. Although some of these efforts may not be directly focused on fostering SRL, they often involve embedding evidence-based pedagogical innovations (e.g., problem- and project-based learning, 2-stage exams, flipped classrooms, reflection) that align with SRL. Research has linked these practices, which encourage active (a term often used in higher education contexts) approaches to learning, to significant improvements in performance, attendance, and student engagement (Freeman et al., 2014). Three examples illustrate how instructors are learning about and bringing supports for active and adaptive learning to their undergraduate courses: a collaboration between a geography instructor and colleagues from a faculty of education; a department-wide initiative involving instructors and science education specialists, and a professional learning collaboration between faculties of arts, sciences, and education, and various university teaching support units.

Geography professor, Timothy Baird, partnered with colleagues from the School of Education (i.e., interested in higher education teaching and learning) in a large public university in the United States. Inspired by an SRL framework, these colleagues sought to develop autonomy supportive classroom instructional practices to better "prepare students for an uncertain future" (Baird et al., 2015, p. 146). To this end, they designed an assignment called "Pink Time" to foster students' intrinsic motivation and

engagement in self-assessment. This was an iterative assignment in which students were instructed to: "skip class, do whatever [you or your group] want [related to the course], and give [yourself] a grade" (Baird et al., 2015, p.148). The assignment was embedded in an applied geography course and mandatory (to be done three times during the course). It was introduced in class with a video in which Daniel Pink describes central themes from his book *Drive* (2009). Students shared their chosen activities and process of learning with their peers in small and large group discussions and completed a self-assessment rubric.

The rubric was co-constructed with students to capture how they engaged with their chosen activities. To facilitate students' task understanding, the instructor modeled/shared a personal example of engaging with the assignment. In a second project, Baird and his education colleagues collaborated with six instructors (Baird et al., 2020), using the Pink Time assignment in five undergraduate and two graduate courses as a strategy to improve students' SRL. Instructors tailored the assignment to their course schedule and teaching philosophy and customized the content, self-grading procedures (i.e., grade yourself anonymously, publicly, no grading) and number of task iterations (i.e., 1, 2 or 3 times) during the course. In both projects (Baird et al., 2015; Baird et al, 2020), analysis of students' self-assessment rubrics provided evidence that the Pink Time assignment nurtured student's sense of control and agency over their learning and led to more active and deeper learning. Collaborative projects like Baird and colleagues' (2015; 2020) show how, together, instructors from different disciplines can combine their respective expertise to design more useful and sustainable pedagogical innovations than either group can design alone (Butler & Schnellert, 2012; Coburn & Penuel, 2016; Perry et al., 2015; Timperley, 2011).

The *Science Education Initiative* (SEI; see Wieman, 2017 for an extensive review) was a department-wide initiative seeking to enhance the quality of undergraduate STEM (Science, Technology, Engineering, and Mathematics) teaching and learning. This initiative was informed by research on teaching and learning and discipline-based education research in science. Its intention was to foster student development of complex problem-solving skills and knowledge of how to learn by embedding empirically effective instructional methods (e.g., active learning) across several courses. Departments within the Faculty of Science in two large research-oriented universities in North America received

funding to support course design and teaching (e.g., organizational structures, materials, faculty incentives). In addition, funding was used to hire science education specialists (aka, SES or discipline-specific teaching experts) as agents of change. SES worked with instructors to transform courses (e.g., support design, implementation, and evaluation of evidence-based educational practices) and enhance their knowledge of teaching and learning research. Instructors had access to an extensive repository of materials to support their learning about educational outcomes, effective pedagogical approaches, and educational technology. Faculty members based their course design (i.e., curriculum, teaching and evaluation) on goals (i.e., to do with content, disciplinary skills, and general habits of mind) they wanted their students to attain, and they systematically evaluated the effectiveness of their teaching. Changes in teaching practice to achieve desired learning outcomes were informed by student learning —what they should be learning in relation to what they were actually learning—and assessed through interviews, observations, surveys, analysis of exam results, and previously validated content assessment instruments. Collaboration amongst instructors was encouraged.

The SEI brought extensive and sustainable changes to teaching practice (e.g., adoption of learning goals, infusion of active learning activities and assessments) and to the learning culture (e.g., thinking differently about teaching) within some participating departments, as well as improvements in student learning and academic performance (Wieman, 2017). In addition, this ten-year initiative highlighted institutional, departmental, and faculty affordances and barriers influencing instructors' decisions about innovating in their teaching. For example, organizational structures (e.g., teaching initiative committees, incentives to engage in the scholarship of teaching, SES coaching, opportunities for personalized goal-directed learning), observing positive outcomes in student learning, instructors' ownership over course organization, and support (i.e., from department/faculty administrators, colleagues, and student assistants) were identified as elements that facilitated instructors to engage in changing their teaching. Factors such as lack of time to learn/implement new teaching practices, perceived impact on their research agenda, or skepticism about the benefits of teaching innovations were barriers to some instructors' change in their teaching practice (Wieman, 2017). This is consistent with other research findings (Bathgate et al., 2019;

Foster, 2014, Weller, 2019). Large-scale efforts like the SEI hold promise for improving teaching and learning, including SRL, in undergraduate courses in a sustainable manner. Projects like the SEI create space and time for instructors to get actively involved in designing and implementing teaching innovations and collaborating with colleagues. Instructors involved in such projects report increased sense of satisfaction from making a difference in student learning (Marincovich, 2007; Wieman, 2017). Capitalizing on the strengths of these projects, a way forward for embedding SRL supports in university classrooms may be to develop partnerships that leverage disciplinary and SRL expertise through collaborations between subject matter experts (course instructors) and experts about teaching and learning (could be SRL researchers —who likely also are educators) (Foster, 2014; Halbert & Kaser, 2021).

Finally, a larger scale collaboration, "Empowering Students Through Self-Regulated Learning: Fostering Students' Self-Awareness as Learners and Capacity for Academic Success," involved instructors and administrators from the Faculties of Arts (FoA) and Sciences (FoS), SRL experts from the Faculty of Education, and educational consultants from the Centre for Teaching and Learning and Technology (CTLT) at a major university on the West Coast of Canada. This project was initiated by administrators in the FoA and FoS, who asked the SRL researchers and educational consultants to serve as resources for a small group of instructors (three FoA and three FoS) interested in supporting SRL in their content courses (i.e., sociology, academic writing, physics, biology, math). Participating instructors had participated in prior projects that sought to embed student-centred teaching practices in their content courses. In addition, some of these instructors held educational leadership positions within their departments. The collaborations were anchored in a co-designed model of support to fit the instructors' interests and needs. Each instructor formed an SRL Innovation Team to bring SRL supports to their undergraduate courses. The six teams included: an academic lead (i.e., the course instructor); an SRL pedagogical coach (affiliated with the FoE, the same person served all six teams), who supported instructors in designing, implementing, and evaluating the SRL supports; and a student academic/research assistant who helped instructors carry out various tasks (e.g., collecting/analyzing data). Some teams also

included some combination of instructors' colleagues, educational consultants from CTLT, or disciplinary pedagogical coaches who contributed their expertise to individual projects.

The project launched with two workshops led by the SRL researchers who introduced the group to SRL theory and supportive practices. During these workshops, teams had time to plan their individual projects to mobilize SRL theory in their courses over one or two academic terms. Going forward, teams decided to manage their own schedules and activities (i.e., there were no more cross-team meetings), with team members determining when and how to interact with each other to meet their project goals throughout the year. Each team adapted the contents of a brief survey to their context. It measured students' sense of competence and control about specific learning activities (see Roll et al., 2018). Its implementation varied from course to course but in most cases the survey was administered at the start and end of the course. Instructors were interviewed at the end of the project to gather their perspectives on how their supports affected student learning and on their experience in the project. Survey and interview data pointed to positive outcomes for students (e.g., positive changes in attitudes towards academic performance, enhanced metacognitive knowledge) and faculty. The instructors reported that being actively involved in (re)designing and trying SRL innovations in their courses enhanced their teaching practice. However, some highlighted how having collaborative opportunities across teams would have been productive. After the project ended, some instructors continued to embed SRL supports in their teaching practice, have presented on this topic at conferences (e.g., Ferreira et al., 2021; Nomme et al., 2021; Rieger et al., 2021), and are preparing manuscripts for publication.

Collaborative approaches to professional learning, like those described above, invite educators to critically engage with novel ideas about teaching and learning, grounded in theory and research, and then apply these ideas (new learnings) to their teaching practice (Halbert & Kaser, 2021; Penuel et al., 2020). In addition, they offer guided and sustained support to design and implement innovations and allow for the formation of communities of like-minded colleagues to continue developing teaching innovations that reach new cohorts of students even after a project ends (Butler et al., 2015; DeLuca et al., 2015; Garrison et al., 2000; Perry et al., 2015; Randi & Corno, 2007). Reframing higher education teaching as inquiry,

where university instructors engage in discussions with colleagues can advance their understanding and practice about teaching and learning (Pekkarinen et al., 2020; Weller, 2019). Through dialogic sharing and reflection on action, new situated knowledge emerges (Stoll, 2009), which has high transformational potential for those involved in the collaboration (Foster, 2014). Drago-Severson and Blum-Stefano (2018) define transformational learning as growth-oriented shifts in one's perspectives and practices resulting from acknowledging others' views and challenging the ways in which one sees and acts in the world. These authors suggest transformational learning is relevant to addressing educational practice challenges, such as engaging undergraduate students in learning how to learn or developing SRL.

Fostering SRL in the Classroom

Effective Teaching Practices in Postsecondary Settings

Chickering and Gamson (1987; 1999) identified research-based principles for effective teaching and learning in undergraduate education. They highlighted positive and supportive interactions among students and between faculty and students as relevant to foster motivation and engagement in deep and meaningful learning. Likewise, they suggested that respecting student diversity (i.e., offering students opportunities to learn in ways that work for them) and trusting in students as learners and knowledge makers encourages student engagement in active learning. Pekkarinen et al. (2020) invited a group of instructors (n=26) who were participating in an educational development project (i.e., flipped learning) and had formal pedagogical training to complete a questionnaire about their perceptions of a "good university teacher." Instructors in this study identified building supportive relationships with students and considering their diverse approaches to learning as salient characteristics of effective teachers. Similarly, students asked to identify characteristics of effective teachers described instructors who are available, demonstrate they care about students' success, and value students' views and contributions (Buskirk-Cohen & Plants, 2019; Helterbran, 2008; Hu, 2020; Miron & Mevorach, 2014).

Principles for effective teaching and learning also point to some pedagogical approaches as effective in enabling productive learning (Chickering & Gamson, 1987; 1999). These approaches include support and guidance through formative feedback as well as the creation of opportunities for students to

collaborate with peers and get actively involved in processing and integrating information (e.g., through challenging discussions, group projects, and authentic and extended projects). Instructors and students perceive that besides subject matter knowledge, instructors' teaching pedagogy is an essential feature of effective teaching. Both instructors and students have reported that opportunities for students to engage in authentic, active, and dialogic knowledge-making are perceived as effective teaching practices (Helterbran, 2008; Hu, 2020; Miron & Mevorach, 2014; Pekkarinen et al., 2020).

These principles for effective teaching have been taken up by scholars (e.g., Ambrose et al., 2010; Dumont et al., 2012; Entwistle, 2012; McKeachie, 2007), endorsed by research (Freeman et al., 2014; Theobald, 2021), and translated to practice by many instructors across time and institutions (e.g., Gibbs & Simpson, 2004; Marincovich, 2007; McGuire, 2006; Stains et al., 2018; Wieman, 2017). However, the majority of undergraduate teaching continues to rely on teacher-centred knowledge transmission practices and passive learning, which limits student development of and engagement in active learning, or SRL (De Corte, 2016; McGuire, 2006; Weller, 2019). Research in K-12 classrooms, where a focus on teaching students learn how to learn is prioritized, may help to reframe teaching and learning in postsecondary settings.

SRL Supportive Principles and Practices

Classroom based-research about self-regulation and self-determination in K-12 contexts (Perry, 2013; Perry et al., 2018; Reeve, 2006; Reeve & Jang, 2006; Stefanou et al., 2004) has described how educators create classroom-wide opportunities for students to develop and engage in autonomous learning. In particular, Perry and colleagues have described how teaching toward SRL involves providing structural support (e.g., in tasks or visual displays, or through routines that can be applied across tasks/activities); supporting student autonomy; offering effective scaffolds when content and/or skills are new or challenging; and creating a community of learners that bolsters students' sense of belonging and confidence (Perry et al., 2018; Perry, Lisaingo et al., 2020; Perry, Mazabel et al., 2020). Table 2.1 summarizes principles and practices for supporting SRL in classrooms.

Table 2.1.

SRL Supportive Principles and Practices

Principles	Practices
Create a community of learners	- Partnering with students in knowledge making - Creating a positive and non-threatening space for learning - Fostering peer-to-peer support and collaboration
Provide supportive structures	- Establishing/co-constructing participation structures and routines - Discussing/co-constructing expectations and instructions - Implementing authentic tasks that have multiple instructional goals, offer students opportunities to be metacognitive and strategic over time, and value diversity
Support student autonomy	- Giving students choices, involving them in decision making - Offering opportunities to control challenge - Offering opportunities for self-assessment
Offer effective scaffolds, instructional supports	- Modeling, demonstrating, asking metacognitive questions - Engaging students in dialogue about learning processes - Providing formative feedback

Adapted from Perry et al., 2018

The practices outlined in Table 2, and elaborated below, have not only proven effective for supporting SRL, but they have also been successful in improving students' academic engagement and success across academic settings over the life span (Dignath & Büttner, 2008; Hoops et al., 2016; McKeachie, 2007; Perry, Lisaingo et al. 2020; Pintrich & Zusho, 2007). In addition, they are associated with positive social and emotional outcomes for learners (Perry et al., 2018; Zimmerman & Schunk, 2011), and they have proven helpful for including students with exceptional learning needs in general education classrooms and supporting improvements in their SRL (Perry, Mazabel et al., 2020).

Creating a Community of Learners. Fostering a community of learners within the classroom is essential to creating an SRL supportive environment (Perry et al., 2018). Brown and Campione (1996) characterize communities of learning as contexts in which instructors and students are partners in knowledge building. Together, they establish norms for participation and collaboration that lead to deep learning and meaningful knowledge construction. Creating a positive and non-threatening space for learning in the classroom, where learning is focused on student progress and growth, is essential for students to feel represented, supported, and safe about experimenting with their learning (Perry et al.,

2018). In such spaces, educators have high but realistic expectations for students, interactions are positive, and all students are valued as learners and contributors to the classroom learning experience (Perry et al., 2018; Reeve & Jang, 2006; Stefanou et al., 2004). In addition, students are encouraged to consider mistakes as learning opportunities and adaptive help-seeking is seen as a productive strategy to regain control when learning gets off track (Hoops et al., 2016; McKeachie, 2007; Wilson, 2004).

In communities of learning, peer-to-peer collaboration is encouraged. These collaborations create opportunities for students to articulate their ideas, think about themselves and others as learners, and learn with and from others (McKeachie, 2007; Perry et al., 2018). Collaborative work invites social forms of regulation and strategic approaches to learning, and enables students to uncover and resolve misunderstandings, engage in deep thinking (Hadwin et al., 2018), and nurture social interactions and personal interests (McKeachie, 2007). Research suggests that engaging postsecondary learners in collaborative work enhances academic motivation, deep understanding, and academic performance (Beishuizen, 2008; Kitsantas et al., 2008; Pintrich & Zusho, 2007; Wilson, 2004).

Providing Supportive Structures. SRL supportive structures offer students information about how to regulate in specific learning contexts (e.g., discussion forums, peer editing, independent projects), which enables them to interact and engage productively with activities (Perry et al., 2018). Supports for SRL can be provided through various structures including predictable/familiar participation formats and routines; clear expectations and instructions; design features of tasks; and even course syllabi. Establishing or co-constructing routines (e.g., how learning sessions will typically unfold) and familiar participation structures that can be applied to different tasks and activities helps students be intentional in the ways they approach learning (Perry et al., 2018). Explicit discussions about general and task related expectations and instructions support students' development of situated metacognitive knowledge and skills (i.e., What am I being asked to do? What do I bring to this task? What strategies can I use?) and prompt their engagement in cycles of strategic action (Nicol & Macfarlane-Dick, 2006; Perry et al., 2018). SRL supportive structures are often provided through activities that become the context to embed other SRL supports (e.g., choice, feedback) (Perry, 2013; Reeve, 2006).

Supporting Student Autonomy. Prioritizing student perspectives and being responsive to their goals, needs, values, and interests during learning activities helps them feel in control and take control of their learning (Reeve & Halusic, 2009). Autonomy supports can be provided by giving students choices, control over challenge, and opportunities to engage in assessment processes (Perry, 2013; Reeve, 2006; Stefanou et al., 2004). Research suggests that autonomy supports have a positive impact on students' motivation for learning, engagement in deep-level thinking, and academic outcomes (Perry, 2013; Reeve, 2006; Stefanou et al., 2004). Autonomy promoting opportunities require adequate support and structures (e.g., clear expectations, feedback, learning activities with optimal challenge) to meet students where they are at in their learning and nurture their intentionality in learning (Katz & Assor, 2006; Reeve, 2006).

Perry et al. (2018) suggested educators can give students a voice in their learning process by giving student choices and involving them in decision making. Choices that require students to ponder the demands of tasks (e.g., where to work, who to work with, resources and learning strategies to use), reflect on their learning strengths and challenges (e.g., when selecting a research topic), and decide and justify their learning approaches can enhance student motivation and metacognitive knowledge and skills (Cleary, 2018; Stefanou et al., 2004). Students can also be given influence over their learning through opportunities to control the level of challenge presented by tasks or activities (e.g., allowing them to determine ways of demonstrating their learning and involving them in co-constructing criteria for success, standards, and goals (Davies & Herbst, 2013; Hattie & Timperley, 2007; Reeve & Jang, 2006; Weinstein et al., 2006).

Finally, engaging students in self-assessing the quality of their work, learning in progress, and required next steps in relation to their learning goals also supports their autonomy in learning (Perry et al., 2018). Self-assessment is most productive to enhance SRL when students have opportunities to incorporate self-generated feedback in later work or when they are engaged in forward thinking about themselves as learners in relation to tasks (Butler et al., 2017; Weinstein et al., 2006). In this way, students can apply to future tasks what they learn about their approaches to learning as well as recognize when they need further supports. Engaging students in planning and self-reflection activities (e.g.,

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Hadwin et al., 2012) can be useful to engage students in productive cycles of strategic action to approach current and future tasks (McCardle & Hadwin, 2015; Weinstein et al., 2006; Zimmerman et al., 2011).

  Offering Effective Scaffolds/Instructional Supports. Teachers, peers, or tools can prompt SRL by providing students with just enough and just-in-time instructional scaffolds such as modeling, strategic questioning, fostering dialogue about learning, and offering formative feedback in on-going activities (McKeachie, 2007; Perry, 2013; Perry et al., 2018; Perry, Mazabel et al., 2020; Reeve, 2006). These supports are co-regulatory when students recognize them as prompts to engage in SRL (Hadwin et al., 2018).

  Modeling and demonstrating enable learners to view and experience how others approach tasks as well as how others process emotional and motivational information throughout learning. Strategic questioning gives learners the opportunity to explore and articulate their own learning process and reflect on their performance (e.g., explaining the how and why of their learning) (Butler, 2002; Hoops et al., 2016). Together, these practices help students develop discipline-specific culture and work habits (Hoops et al., 2016; Weinstein et al., 2006), adaptive approaches to learning (Butler, 2002; McKeachie, 2007), and positive motivational beliefs and attitudes (Cleary, 2018). Inviting students to make their thinking and learning processes 'visible'— to self-generate feedback— (e.g., through individual reflection or small group discussions) (Cleary, 2018; Nilson, 2013; Weinstein et al., 2006) engages students in metacognitive processes that can prompt their strategic engagement in learning activities. Likewise, offering them just-in-time formative feedback (i.e., descriptive, task-focused) linked to specific actions and goals (i.e., Where am I going in my learning?) engages students in self-monitoring and self-assessment (i.e., How am I doing?) to guide future learning (i.e., What's next?) (Hattie & Timperley, 2007; Nicol and Macfarlane-Dick, 2006; Wilson, 2004). Learners use internal and external feedback to update domain specific knowledge, metacognitive knowledge, self-beliefs, beliefs about tasks, and strategies (Butler & Winne, 1995). However, each learner interprets feedback differently, depending on their emotions, motivational beliefs, and perceived support in the learning environment (Hattie & Timperley, 2007; Nicol & Macfarlane-Dick, 2006).

These principles and practices compliment those for effective teaching in higher education. They offer a cohesive and flexible framework that emphasizes the importance of tasks, instructional practices, and interpersonal interactions and transactions to support student engagement in effective forms of SRL (Perry, 2013; Perry et al., 2018). Informing university instructors about SRL supportive practices while offering them support and opportunities to translate these to their teaching practice, may empower them to develop a repertoire of context-sensitive SRLSPs and bring desirable and sustainable changes to undergraduate teaching and learning.

Summary

SRL, as a situated teaching and learning framework (Butler & Cartier, 2018; Zusho, 2017), can support many of the teaching and learning objectives in post-secondary settings today and address many challenges students experience in those contexts. Fostering the development and enhancement of SRL at the postsecondary level is relevant because SRL can enable university students to navigate cross-disciplinary expectations (Hadwin & Winne, 1996; Steiner 2016) and because student engagement in SRL has been linked to academic success across disciplines (Dörrenbächer & Perels, 2016; Kitsantas et al., 2008).

Efforts to support SRL in higher education have focused on particular groups of learners and been provided, mainly, outside classrooms. However, research in K-12 settings has established that classroom-based supports for SRL can be effective for improving student learning and wellbeing in inclusive contexts (Dignath & Büttner, 2008; Perry, Lisaingo et al., 2020; Zimmerman & Schunk, 2011). Also, efforts at contextualizing teaching innovations, aligned with SRL, within content courses at universities has provided evidence about how SRL might be used as a teaching and learning framework in this context too (Baird et al., 2020; Butler, 1995; De Corte, 2016; Ferreira et al., 2021; Steiner, 2016; Theobald, 2021). Yet, more work involving instructors in learning about, developing, and implementing SRL supports in their undergraduate courses is needed to make SRL instructional innovations widespread and sustainable.

Using SRL promoting principles and practices emerging from classroom-based research (Reeve, 2006; Perry et al., 2018) to inform university instructors teaching practice may prove helpful in this regard. Also, inviting instructors to engage in SRL-informed collaborative and individual inquiry and offering them sustained guidance as they mobilize SRL theory into their practice (Butler et al., 2015; Perry et al., 2018) seems important. Combining research with professional learning may result not only in advancements in SRL theory and research, but also in improved teaching practice and student academic outcomes (e.g., Butler & Schnellert, 2012; Perry et al., 2018; Perry, Lisaingo et al., 2020; Timperley et al., 2009).

Chapter Three: Methodology

This study had three purposes. The first was to document how a group of university instructors included SRL promoting practices in their undergraduate courses as they participated in research-based inquiry about teaching and learning. The second was to probe university instructors' and students' perspectives about SRL supports in undergraduate courses. The third examined whether and how the instructors' engagement in SRL-focused inquiry enabled them to advance their teaching and professional practices.

Four research questions addressed these aims:

1. How did participating instructors infuse opportunities for SRL in their undergraduate courses?

2. How did instructors perceive supporting SRL in their undergraduate courses?

    i.   How did instructors perceive the effectiveness of these practices to meet the SRL goals they identified for their students?

    ii. How did instructors perceive these practices made a positive difference in student participation and performance?

    iii. What factors did instructors perceive as affording and/or constraining their efforts to support SRL in their courses?

3. How did students experience the SRL opportunities offered in their courses?

4. What roles did a Community of Inquiry (CoI), as a collaborative structure, and individual inquiry, as a process, play in helping this group of instructors translate and mobilize SRL research in their practice?

Design

I used a multiple case study design with a participatory approach (i.e., collaborative inquiry) to address my research questions. The case studies examined how five science university instructors used SRL supportive practices (SRLSPs) in their undergraduate courses to support students' content learning and SRL. Each instructor engaged in iterative cycles of planning, enacting, reflecting, and adapting their

SRL-focused teaching practice as the academic term unfolded. The instructors and I formed a Community of Inquiry (CoI) as a vehicle through which we engaged in collaborative inquiry, exchanging information about SRL and what was going on in relation to SRL in their courses. We met as a group and built on each other's knowledge and experience about fostering SRL in undergraduate courses.

Figure 3.1 presents the five case studies that comprised this research. In each case, an instructor's SRL focused teaching practice (unit of analysis in green) is situated in the context of an undergraduate course (dashed lines). Four instructors implemented SRLSPs in courses they were teaching and observed students' uptake of those opportunities to inform their practice. One instructor was not actively involved in teaching during the data collection period but wanted to be involved in the CoI to reflect on previous and future course offerings.

Figure 3.1

Multiple Case Study Design: Context, Cases (Pseudonyms), and Unit of Analysis
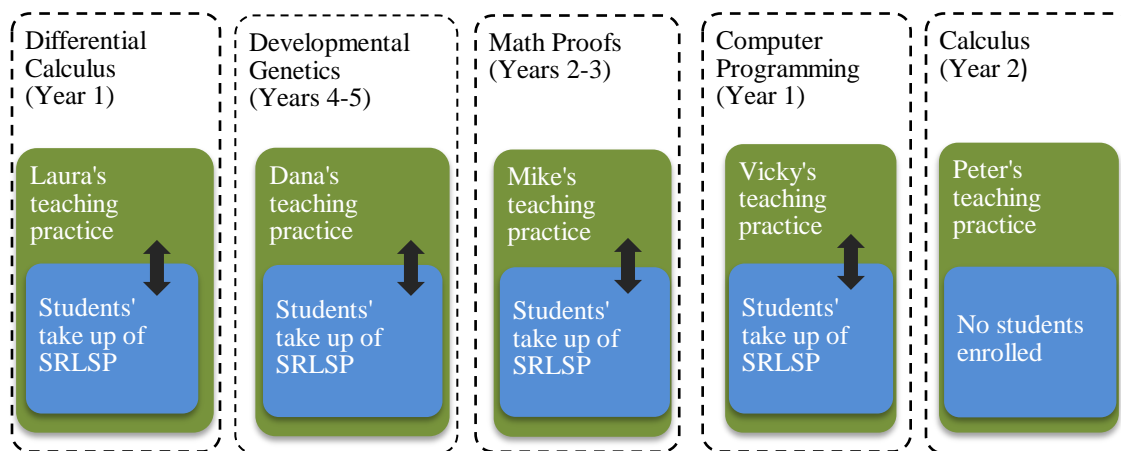
A case study design was well suited for this research because it sought to explore and describe instructors' SRL focused teaching practice in depth as it occurred in its natural setting and while considering participants' perspectives (Butler, 2006). Yin (2018) suggests case study research is appropriate to address 'how' and 'why' questions about contextualized contemporary phenomena over which the researcher has little control (e.g., overlapping individual and contextual factors in SRL). I chose

to include multiple cases of instructors who were engaged in teaching and learning activities that were relevant to the foci of my study to draw cross-case conclusions and strengthen the study's reliability.

Case study designs allow for dynamic and adaptive approaches to inquiry where data collection, interpretation, and representation occur simultaneously and inform each other (Butler, 2011). Similarly, case study designs enable the collection of multiple types of evidence to generate richer data and find patterns to construct meaning (Marshall & Rossman, 2016; Yin, 2018). These methodological strengths were relevant to the foci of my study. SRL is influenced by individual and social processes; it is multi-componential, situated, and recursive. As such, studying SRL warrants the use of different types of data (Butler & Cartier, 2018; McCardle & Hadwin, 2015; Winne & Perry, 2000). Hence, I designed a dynamic and recursive research process (described below) and collected multiple types of data (i.e., self-report questionnaires and interviews, observations in the form of running records, and documents) from different sources (i.e., instructors, researchers, students) over time as evidence to address the research questions. Butler and Cartier's (2018) situated model of SRL and Perry's SRL supportive principles and practices (2013; Perry et al., 2018) informed the definition of the cases, the selection and design of data collection procedures and tools, and the interpretation of findings.

Using a participatory and collaborative approach was also a good fit for my study because I sought to acknowledge and build from the participants' situated knowledge and experience (Bergold & Thomas, 2012; Butler, 2006; Kemmis & McTaggart, 2005). Such an approach to investigating SRL teaching and learning has been successfully used to enhance both the educators' teaching practice and student learning in the K-12 school system (e.g., Butler & Schnellert, 2012; Butler et al., 2013; Cartier et al., 2010; Perry et al., 2015; 2018; Perry, Lisaingo et al., 2020; Timperley et al., 2009), but is scarce in postsecondary settings (Beaumont et al., 2016; Beishuizen, 2008; Butler, Elaschuk & Poole, 2000)

Study Context

I conducted this study at a large research-oriented university on the west coast of Canada where I invited instructors in the Faculty of Science (FoS) to form a partnership to understand and implement SRL supports in undergraduate courses. This context was a good fit for my study because this university,

and the FoS within it, have an established culture of supporting faculty involvement in the scholarship of teaching and learning. With dedicated units at the university and faculty levels encouraging and supporting instructor engagement in initiatives aligned with enhancing teaching and learning practices, instructors welcomed the invitation to infuse their teaching practice with opportunities for SRL.

At the university level, the Center for Teaching, Learning and Technology (CTLT) offers research-based programs and services (e.g., workshops, consultations, peer coaching, and communities of practice) to support instructor professional growth in teaching and learning. Also, in partnership with the university's administrative and academic units, CTLT supports course development and delivery, as well as initiatives that develop and enrich the educational experience of students. Academic and administrative units, as well as individuals in the FoS (including some participating instructors) have collaborated with CTLT in several teaching and learning projects over time. This study was relevant to CTLT's interests and they supported its implementation by offering meeting space to conduct data collection (i.e., CoI meetings and student interviews were held there).

Within the FoS, there is a dedicated Centre for Learning and Teaching that strives to transform science education. This centre has empowered the teaching and learning community in the FoS by supporting collaboration (including with external partners), research on teaching, and application of evidence-based practices in courses for twenty years. For example, they pair instructors with resources (e.g., training opportunities, science education specialists, grants, knowledge mobilization) to facilitate the implementation of refined teaching and learning practices. The Center has a strong emphasis on building capacity through reflexive professional development and approaches to teaching, as well as by nurturing a culture of informal sharing of teaching and learning practices. Over time, departments and individuals within the FoS have developed teaching and learning innovations that are well aligned with empowering their students to engage in SRL (Science Education Initiatives, 2014; Wieman 2017).

The established engagement of FoS instructors in reflecting on teaching and learning was relevant to the foci of my study. Instructors in the FoS recognized common struggles in students' approaches to learning that impact their academic performance and adaptive use of knowledge (personal

communication, 2015). For example, they had observed that many students had difficulty staying on track and keeping up with the material, using out of class time productively, knowing when and why to recruit learning strategies, and replacing high school study habits with more useful strategies to fulfill university academic demands. Hence, inviting instructors in the FoS to understand and apply SRL supports in and beyond the classroom met the needs of their teaching and learning contexts as well as my research purposes.

Situated, Collaborative, and Individual Inquiry

I used situated, collaborative, and individual inquiry processes (Butler & Cartier, 2018; Halbert & Kaser, 2013). Processes were situated in that instructors were encouraged to identify a focus for SRL that fit with the goals for their undergraduate courses. In addition, the instructors adjusted their teaching practice in real time to meet their needs and what they perceived to be their students' learning needs.

Collaborations were operationalized as a Community of Inquiry (CoI). CoIs are a learning experience in which a group of people collaborate to critically explore a shared topic of interest (Garrison et al., 2000). In CoIs, *knowledge-of-practice* is deliberatively built by drawing on *knowledge-for-practice* coming from people with academic expertise (e.g., researchers), and *knowledge-in-practice* coming from educators' daily practice (Cochran-Smith & Lytle, 2004). Theory-practice connections are socially constructed through dialogical sharing and reflection (Butler et al., 2015; DeLuca et al., 2015; Stoll, 2009) and are informed by the social historical context, as well as by personal and social conceptualizations of teaching and learning (Pekkarinen et al., 2020). In this study, the CoI shared the purpose of exploring how bringing SRLSPs to undergraduate courses could enhance the learning of students. Instructors and I were positioned as co-researchers. We each contributed to the construction of knowledge (declarative and practical) about our shared interest. The instructors were also co-subjects who participated in the activity of embedding SRL supports in their courses.

Halbert and Kaser's (2013) *Spirals of Inquiry* structured the CoI's participatory and collaborative processes. *Spirals of Inquiry* is a successful model of collaborative inquiry for educators that acknowledges and foregrounds their expertise and consists of iterative individual and shared loops of

goal-directed action and reflection much like the cycles of strategic action in SRL (Beishuizen, 2008; Halbert & Kaser, 2013; Timperley et al., 2009). Processes occur in overlapping phases (i.e., scanning, focusing, developing a hunch, learning, taking action, and checking) that are guided by the following questions: What is going on for us and our students? What are my plans and goals to support SRL? What have we done so far? Are we making a difference? What have we learned and what else can we do/learn? The Spirals of Inquiry model guided the CoIs co-construction of knowledge about implementing SRL innovations in content courses. We met five times over the course of the study. At each meeting, we focused on one of our guiding questions, beginning with *What is going on for us and our students?* However, foregrounding one question did not prevent us from acknowledging or addressing the other guiding questions.

Finally, each instructor engaged in individual iterative cycles of action and reflection about their teaching to support SRL in a particular undergraduate course. They identified a focus, planned action, enacted strategies, reflected on their action, and planned for further action (Figure 3.2). The instructors' individual inquiry informed our collaborative inquiry and vice versa.

Figure 3.2

Research Process: Individual and Collaborative Cycles of Action and Reflection
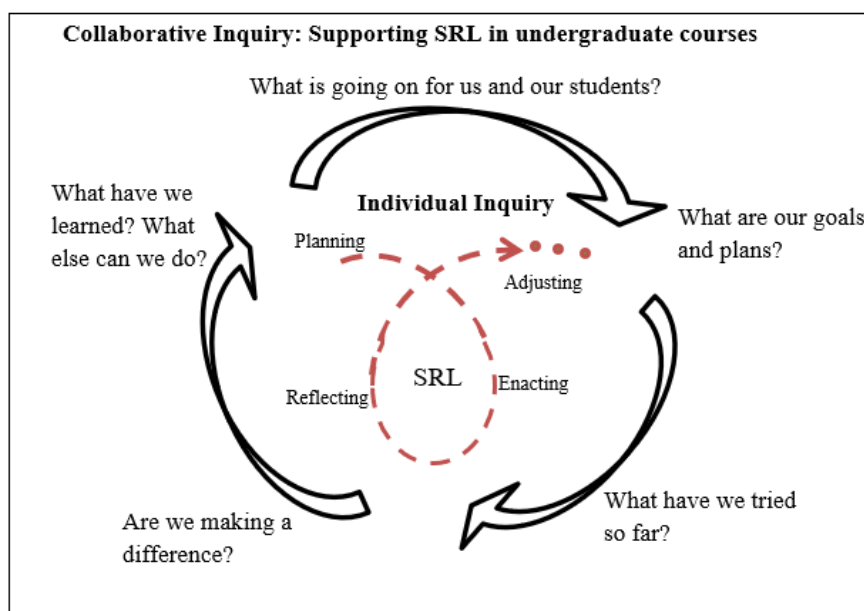
In these ways, participants in the CoI engaged in self-, co- and shared regulation as they identified individual and common goals, individually and collectively planned and strategized how to meet those goals, implemented innovations in their teaching practices, monitored and evaluated progress toward their goals, and then planned for future action.

Researcher Motives and Positioning

I became interested in postsecondary accessible supports for learning when I worked as a learning specialist serving young adults who struggled with learning due to learning disabilities and/or mental health issues. At the time, my job was to offer my clients individual, out of class study skills training, which, given the way I was approaching it at the time, was effective to broaden their repertoire of strategies to complete tasks (e.g., college assignments) but not to develop their ability to use them flexibly in authentic learning contexts (e.g., content courses). These learners had the potential to thrive and were investing time, money, and emotional and cognitive effort to turn their learning trajectory around. Despite their efforts, however, it was just not working. I wondered how learning how to learn in content courses could improve their application of skills and strategies where they were most needed. It was in this clinical context where I met Cali, the undergraduate student I introduced at the beginning of Chapter 1, along with many other struggling learners who motivated me to study how to enhance teaching and learning in postsecondary settings. This interest led me to pursue graduate work in Special Education at The University of British Columbia where I sought to learn about more sustainable and effective supports for learning.

I believe that knowledge making is situated and socially constructed, and that teaching and learning are shaped in context through educators' and students' interactions (Butler & Cartier, 2018; Marshall & Rossman, 2016). With these beliefs in mind, I positioned myself as facilitator, member, and observer in the Community of Inquiry. Nevertheless, I must acknowledge that as the designer of my study, I held a position of power in relation to the participants. I created the CoI, structured the CoI sessions, and contributed a sensitizing theoretical framework (SRL) to guide the instructors' engagement in the research process. However, by adopting a participatory and collaborative approach to research, I

sought to prioritize the instructors' situated experience and invite them to contribute to the research process and design. I kept the design of the study flexible and adaptive to consider instructors' concerns, needs and questions. I invited their input about planned activities, tools, and timeline. For instance, instructors could decide how many times to meet as a group, what areas/topics to focus on in our discussions, and whether more activities were needed to enrich our shared understanding of supports for SRL in undergraduate courses. This was based on the idea that in order to bridge research to practice and contribute to learning outcomes for students, it is essential to involve educators in the research design (Butler et al., 2015). Two of the four research questions emerged through our collaboration and one of these responded to a need for knowledge that the instructors identified. In this reciprocal partnership, I learned with and from instructors but also contributed in important ways to their learning.

As facilitator of the CoI, I sought to create opportunities for all members to contribute knowledge to collectively generate and analyze ways to support student engagement in SRL (Kemmis & McTaggart, 2005). I brought experience from coordinating and collaborating in two research projects using case study and CoI approaches like the one used in this study. In the first, I served as coordinator of a four-year project focused on SRL in music education. In that project, I co-facilitated team meetings (similar to the CoI in my study) where researchers shared SRL theory to inform music educators' teaching practice using an inquiry-based research process (Mazabel et al., 2018; Perry et al., 2018). In the other project, an extended partnership between researchers and educators to study the development of SRL in young children, I supported data collection (i.e., classroom observations), data analysis, and knowledge mobilization. Through these projects, I became familiar with case study methods and the implementation of collaborative, inquiry-based processes. These experiences inspired the design of my study. More importantly, I learned significant lessons about establishing and maintaining trusting relationships with research participants as the basis to co-construct knowledge about supporting SRL in authentic learning environments.

In my study, as a member of the CoI, I was positioned at the same level as instructors in the sense that all of us were participating as knowers and learners, with each of us contributing our expertise to the

process of meaning making (Stringer, 2004). We drew on the sensitizing lens that I offered (SRL) as an outsider expert (i.e., knowledge-for-practice) and the expertise they brought from their subject-specific teaching practice (i.e., knowledge-in-practice) to build our shared understanding of supports for SRL in undergraduate courses (i.e., knowledge-for-practice) (Cochran-Smith & Lytle, 2004). Taking this approach released tensions about potential power dynamics that could have influenced their contributions to the study. For example, they knew that when I took the observer role in classroom visits, they were not the subject of study (e.g., I was not evaluating them). Rather we were partners in studying and applying SRL supports in undergraduate courses. They welcomed the opportunity to have someone to reflect with about SRL innovations in their classroom because while they were in class their primary focus was on teaching the subject matter. Sharing the affiliation to the academic community with them, as well as being a mature student (of similar age to them) with some experience teaching at the undergraduate level, albeit completely removed from the field of science, might have also contributed to increasing their trust in me as CoI creator, facilitator, member, and observer.

All members in the CoI had personal and shared goals to fulfill through our participation in the study. We were all keen on enhancing our understandings about teaching and learning in higher education as well as on developing SRL innovations to improve students' learning in postsecondary contexts. The instructors sought to engage in reflexive teaching practice to advance science education and continue their professional development. On my end, I wanted to exercise reciprocity in my relationship with the instructors, an ingrained value I brought from my clinical background. This value is the reason why I designed a study that could be of immediate practical use to them. I believe these shared and individual goals allowed us to engage in authentic contributions.

One more aspect to acknowledge is my position as researcher in relation to the students. My position fell into a middle ground between being an insider (i.e., I held student status at the time of data collection and shared with them the undergraduate experience) and an outsider (i.e., older than them, a graduate student, with undergraduate experience removed from science, and potentially perceived as an 'ally' of their instructors) which might have influenced recruitment and data collection. However,

students were invited to participate as experts in the sense that their experience with SRLSPs in the courses they were taking was critical to enhancing my understanding of SRL supports in science undergraduate courses. Participating students mentioned they felt empowered by this invitation. Similarly, in the interviewing process, students expressed satisfaction when learning that their contributions would have practical implications for others (i.e., future students' learning could be easier/better/enhanced) or they realized their participation in the study had helped them learn about themselves as learners. Moreover, they participated in the study once they had completed their course requirements but before they received their final grade, so their insights were independent of the instructors' final evaluation over their performance. Despite the different experiences the students and I had, I believe they trusted me as a researcher. They knew I had been working with their instructors throughout the term because the instructors introduced me each time I visited their classes. This extended work with their instructors might have demonstrated my commitment and genuine interest as a researcher in understanding their unique learning experience within the course they were enrolled in.

Participants

Instructors

Recruitment Procedures. Given the focus and situated collaborative inquiry approach of my study, I followed a purposive sampling approach and sought to partner with university instructors in the Faculty of Science who: (a) wanted to reflect on their teaching practice as they taught an undergraduate course; (b) had a particular interest in improving the learning experience of their students; (c) were willing to implement innovations in their classrooms with potential for supporting SRL; and (d) were willing to engage in collaborative inquiry about teaching and learning.

The specific needs for recruiting a small group of participants who met the above criteria resulted in a targeted and lengthy process (14 months) to connect with them. I began this process in an informal meeting with an acquaintance who worked within the Institute of Scholarship of Teaching and Learning in the University's Center for Teaching, Learning and Technology (CTLT) and had collaborated in various projects with instructors in the Faculty of Science (FoS). He was instrumental in connecting me

with an instructor and team member of the Centre for Learning and Teaching in the Faculty of Science. This person showed interest in my research focus and approach and invited me to attend in-house events in which FoS instructors presented ongoing and completed projects on teaching and learning innovations. Attending these events enabled me to interact with FoS instructors and recognize that some questions and approaches they had about undergraduate teaching and learning in their specific contexts aligned with mine. He connected me with eight instructors who were invested in implementing innovative approaches to instruction that could support SRL (e.g., problem-based learning, assessment for learning) and who he thought might be interested in partnering with me for my research. I met informally with each of them to share my research interests and inquiry approach, understand their interests in bringing supports for SRL into their courses, and inquire whether they would be interested in engaging in collaborative inquiry about teaching and learning with me and other instructors in the context of my research. Six of them expressed interest in the study.

Upon receiving ethics approval from my University's Behavioural Research Ethics Board to conduct the study, I formally invited and shared the information letter and consent form electronically with the six instructors who met the inclusion criteria and had expressed interest in being part of the study. I invited them to participate in one or more of six activities, but they could self-exclude or choose not to participate at any time or in any part of data collection without penalty/consequences. I asked the instructors to return their consent form after one week. Those instructors who needed or wanted more time to consider participation were given it. One instructor declined the invitation because she was no longer teaching. Others returned their signed consent forms electronically within one week.

Sample. Five instructors from the FoS participated in the study. Four of them taught an undergraduate course in the Fall term (September-December) of the year the study was conducted, and one chose to focus his inquiry on a course he had taught in a previous term because he was not teaching when the study occurred. Table 3.1 includes demographic information, area of expertise, and teaching expertise for all instructors.

Table 3.1

Instructors' Demographic Information, Area of Expertise, and Teaching Experience

Instructor[1]	Gender[2]	Area of Expertise	University Teaching (yrs.)	Formal Teaching Education
Laura	F	Mathematics	7	Master's degree in math teaching
Dana	F	Biology	8	No
Mike	M	Mathematics	2[3]	No
Vicky	F	Computer Science	6	No
Peter[4]	M	Mathematics/Science	6	Works in postsecondary professional development of teaching and learning

[1] Pseudonyms approved by the instructors. [2] Self-identified gender (F = female; M = male). [3] Teaching assistant for 10 years. [4] Instructor and team member of the Centre for Learning and Teaching in the FoS whose inquiry focused on a course he had taught previously.

All instructors were experts in different fields of science and their teaching experience at the university level ranged from 2 to 8 years. Even though only two of them reported having formal teaching education, all of them had engaged in continued professional development about teaching and learning through participation in workshops, events and projects the CTLT organized, or participation in local, national, and international events and conferences. For some participants, their commitment and engagement to this study fulfilled personal interests beyond those of the study. For example, Laura was interested in learning how to engage in educational research and Peter wanted to experience first-hand a collaborative inquiry approach as a tool for professional development. Table 3.2 presents a summary of the courses including subject, level, times previously taught by participating instructors, and enrolled students.

Each instructor chose an undergraduate course as the context for their inquiry. All focal courses were delivered through the FoS and there was variability in their level spanning introductory, intermediate, and advanced courses. All but one instructor had taught the same course before, but some had more experience teaching it than others (once vs. eight times). A total of 596 students were enrolled

Table 3.2

Undergraduate Courses

Instructor	Course Subject	Level	Times previously taught	Enrolled Students			
				Total	**Gender[1]**	**SSC**	**Year**
Laura	Differential Calculus for Life Sciences	Introductory	0	404[2]	282 F 122 M	Yes	1
Dana	Developmental Genetics	Advanced (elective)	8[3]	35	30 F 5 M	Yes	4/5
Mike	Math Proofs	Intermediate	1	65	26 F 39 M	Yes	2/3
Vicky	Computer Programming	Introductory	2	92	22 F 70 M	Not aware	1
Peter[4]	Calculus	Intermediate	2	145	58 F 87 M	Yes	2

SSC= Some students registered in the university's services center. [1] As reported in institutional enrollment forms; F=Female; M=Male. [2] Two sections. [3] Yearly. [4] Taught this course for the last time the year prior to data collection.

in these courses during the academic term when data was collected (September to December). Class size per section ranged between 35 and 220 students, and class composition varied in terms of gender and how far students were into their program of studies. As for gender, two courses had about 70% female enrolled, one course had >70% male enrolled, and two courses were gender balanced (40% female). Most students enrolled in courses were in the same year in their program. Dana's course (Developmental Genetics) was the exception with 63% of students enrolled in fourth year and the rest distributed in other years. In four of the five courses some students had disclosed to their instructors that they were registered with the university's student services center.

Students

Recruitment Procedures. As part of their commitment to participating in the study, instructors informed all students enrolled in their courses that they were participating in a research study that

involved researchers visiting their classrooms and observing how they taught. In the third CoI meeting (September), when we began thinking and reflecting about the impact of SRL innovations on their students, the CoI members agreed that it was relevant to hear from students about whether and how the SRLSPs the instructors were using were helpful or not for their learning. Including students required an amendment to the original ethics application, which meant students enrolled in the courses taught by the participating instructors were invited to join the study toward the end of the course (November). This also meant their input was not used to inform instructors' cycles of inquiry during the study but shared with them after the study to inform their future teaching.

Student recruitment was done with instructor cooperation. They granted me permission to use five minutes at the end of class (once they had left the room) to inform students present that day about this addition to the study and distribute information letters and consent forms. Students were invited to participate in one or two activities once they had completed their course requirements: (a) a one-hour individual interview or a focus group with other students enrolled in the same course; and (b) work sample sharing. Students were encouraged to return their signed consent form directly to me on that day or those needing more time to decide could return it electronically within one week. This procedure ensured that the instructors were blind to student participation in the study. No student was excluded if they needed or wanted more time to consider participation.

Sample. Sixteen students[2] (31% self-identified as male, 69% self-identified as female) across four courses participated in focus groups or individual interviews. Student data was not collected in Peter's course because he did not enroll students when the study was conducted. The students ranged in age from 18 to 28 years old (M= 20.6, SD= 2.6) and participating students were enrolled across different years in their program of studies with seven students in first year, three in third year, and seven in fourth

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[2] Low enrollment of students in the study may be attributable to the fact they were recruited toward the end of the term/course when time pressures are greatest.

year. These students were enrolled in different programs in the FoS (e.g., Biology, Engineering, Geography, Applied Science). Twenty-one students, including those who were interviewed, also shared work samples. However, work samples were not included in the analyses for this dissertation because there were not enough data from all courses to describe how most students enrolled were taking up SRLSPs implemented by the instructors. Table 3.3 summarizes demographic information for the students who chose to participate in the study and indicates research activities in which they were involved.

Table 3.3

Student Demographic Information and Involvement in Research Activities

| Instructor | # of Ss (Gender[1]) | Age (M) | Programs | Year | Involvement in Research Activities (# of Ss per activity) | |
					Focus Groups	Individual Interviews
Laura	3 (F)	18.33	Science	1	2	1
Dana	7 (6F;1M)	21.7	Science, Biology, Biotechnology, Biophysics, Dev. Biology	4, 5	6[2]	1
Mike	2 (1F;1M)	24	Engineering, Geography	3	2	0
Vicky	4 (1F;3M)	18.3	Applied Science, Engineering	1	0	4

Ss = Students; Dev. = Developmental; [1] Self-identified gender (F= female; M=male). [2] Two students per focus group.

Data Collection

Data collection lasted ten consecutive months and was tied to the instructors' teaching of a course over one academic term in order to contextualize SRL supports within a natural time and space and consider affordances and constraints within a typical university teaching and learning setting. Data collection occurred in three phases, subsequently referred to as: (a) laying the ground; (b) bridging research to practice in real time; and (c) listening to student voices (Figure 3.3). I collected multiple types

of data (i.e., self-report questionnaires and interviews, observations in the form of running records, and documents) over time as evidence to address the research questions. However, given the cyclical nature of this research, some data were collected more than once during the study.

Figure 3.3

Data Collection Chronological Timeline
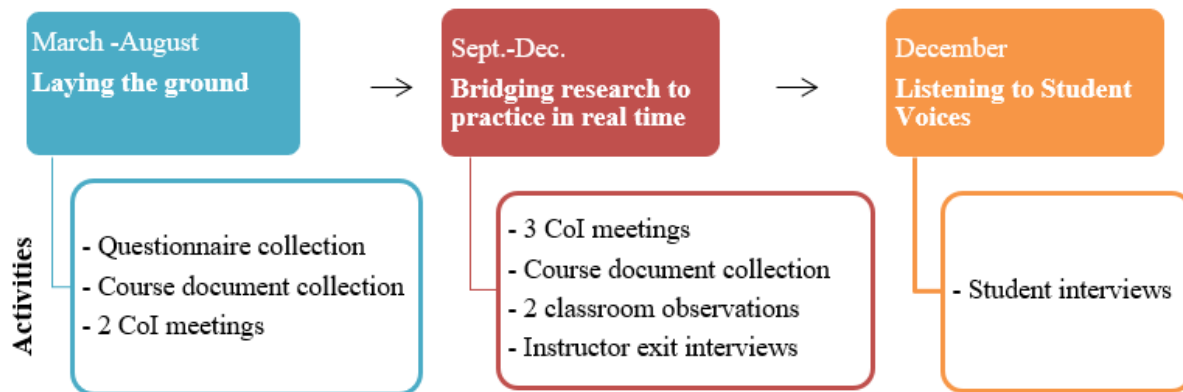
During phase 1, *laying the ground* (March to August), the focus was on collecting data to understand the instructors' teaching backgrounds and the characteristics of the focal course they had chosen for their inquiry. During this phase individual and collaborative inquiry processes began as the CoI met twice. In phase 2, *bridging research to practice in real time* (September to December) the instructors were actively engaged in teaching (except Peter) and implementing SRLSPs to meet their goals in relation to supporting SRL in their undergraduate courses. They shared information about their focal course (e.g., number of students enrolled) and documents that showed how they had implemented SRLSPs in their courses. Throughout this phase we continued with individual and shared inquiry processes (3 CoI meetings) and I visited their classrooms to observe both the instructors' use of SRLSPs and the students' uptake of the opportunities for SRL. At the end of this phase I interviewed the instructors to gather their perspectives about the impact SRLSPs had on their students and whether and how supports for SRL fit their working context. In the third phase, *listening to student voices,* I interviewed students enrolled in the focal courses to gather how they perceived the opportunities to

engage in SRL were perceived supported them, or not, to take control over their learning.

In the next section, I describe the data collected within the following categories: background information, inquiry processes, classroom observation processes, and interview processes (summarized in Table 3.4). Data were collected across different places on campus including meeting rooms provided by CTLT; classrooms where undergraduate courses were delivered; and in the instructors' offices.

Table 3.4

Type and Sources of Data

Data Type	Source
Background Information	Instructors
General Information Questionnaire (Parts A and B)	
Course Documents	
Inquiry Processes	
Reflection Templates	Instructors
Check-out slips	
CoI Meeting notes	Researcher
CoI Meeting audio records	CoI
Classroom Observations Processes	
Classroom observation running record	Researcher
Brief interviews	Instructors
Interview Processes	
Instructor exit interview	Instructors
Student interview	Students

Background Information

In this section I describe tools used to collect background information about the instructors and focal courses as well as documents that the instructors shared to support their SRL-focused teaching.

General Information Questionnaire. This questionnaire was divided into two parts (refer to Appendix A). Part A was administered at the beginning of the study to gather information about the instructors (i.e., demographic); their teaching background (i.e., university teaching experience, discipline, formal teaching education); the course they chose as their focus for this inquiry (i.e., subject, level, size,

years teaching it); and their perceived strengths, challenges, and approaches to teaching and evaluating this particular course. Part B was administered at the beginning of the academic term (September). It inquired about the context and characteristics of instructors' respective focal courses (i.e., subject taught, number of enrolled students, and demographic characteristics of the class). Digital copies of both questionnaires were sent and returned via email.

Course Documents. Throughout the study, the instructors selected and shared documents related to their focal course via e-mail. At the beginning of the study, they shared documents used in previous versions of the course including syllabi, course calendars, and assignment examples. Some of these documents were designed by the participating instructors. All documents were collected as evidence of what these courses looked like at the start of the study (prior to the first CoI meeting), with specific focus on whether/to what extent the instructional practices presented in those documents reflected SRL supports. In the following months, the instructors continued to select and share documents (e.g., class presentations, assignment instructions, online course repositories, grading rubrics, samples of instructor assignment feedback, and grading practices). These documents were evidence to understand how the instructors operationalized their plans for supporting SRL (as indicated in CoI documents and brief interviews) throughout the study. Some of these documents were also used to support/prompt discussions in the CoI such as considering ways to bring supports for SRL into a course through assignments, lecturing or course design. Similarly, these documents were used to inform both the exit interview with the instructors and the protocol for student focus groups and interviews.

Inquiry Processes

In this section I first introduce the CoI meetings as the context where individual and collaborative inquiry processes were documented to then describe the data collected.

CoI Meetings. These meetings were a dedicated space and time for the instructors to share their SRL-focused teaching practices and reflections. All CoI members shared an interest in exploring teaching practices to support undergraduate student productive learning, as expressed in recruitment meetings. Based on my previous conversations with the instructors, I suggested a shared inquiry goal in

our first CoI meeting: To think about, design, implement, and/or evaluate instructional strategies aimed at engaging undergraduate students in SRL. The instructors agreed to pursue the proposed inquiry goal as it aligned with their professional development interests and met their need to make a difference in the learning of their students. The CoI met five times between May and December of the year in which data collection took place. Meetings were held in meeting rooms at CTLT, lasted 90 minutes, and were audio recorded. The number and length of meetings was agreed upon with the participating instructors and light refreshments were always provided. During each CoI meeting, participants learned about SRL principles and supportive teaching practices, and we collaboratively planned and reflected on their teaching practices to support their students' development of and engagement in SRL. Hence, meetings were anchored on the instructors' actions and reflections of their teaching.

All meetings had a similar structure. Meetings began with a 'check-in' during which the instructors reflected on and shared what they had been thinking about, trying, and observing in their classes in relation to supporting SRL. Then, we engaged in a focused discussion about topics all members in the CoI wanted to explore (e.g., what does the research say about SRL in post-secondary settings?). At some point during the meetings, the instructors had time to complete the reflection templates (described in detail in the following section, also shown in Appendix B) to document their inquiry process over time. Finally, the instructors completed a 'check-out' slip (described in the following section and shown in Appendix C) to summarize their learning from the session and inform subsequent meetings. In between meetings, the participants implemented their teaching plans while the researcher observed in their classrooms (twice in the term) and provided opportunities for instructors (i.e., debriefing interviews) to reflect on how their efforts to build supports for SRL in their courses were working. Right after each CoI meeting, I recorded my thoughts and reflections about how the CoI meeting unfolded. Audio recordings and CoI field notes were used to plan subsequent meetings, to document the group dynamics and processes, and to get an accurate record of the instructors' thoughts and reflections as expressed during the meeting. Figure 3.4 shows the cyclical and situated nature of individual and collaborative inquiry. CoI

members had access to a digital repository of resources that housed CoI meeting slides, articles, and inspirational examples that we all contributed.

Figure 3.4

Cyclical and Situated Nature of Instructors' Inquiry
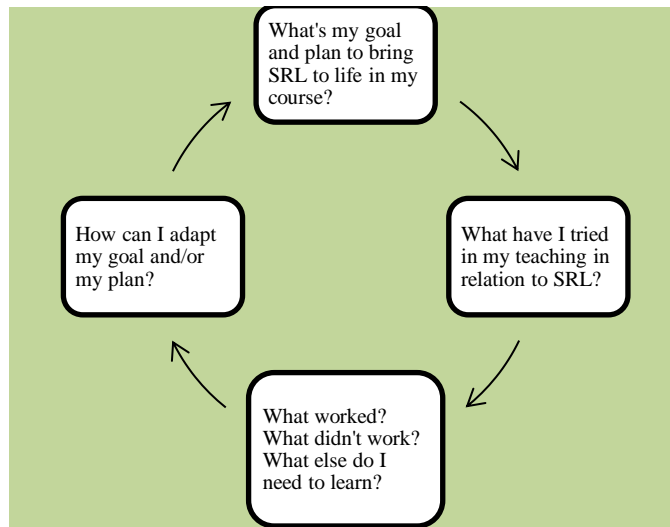
Even though CoI meetings followed a similar structure, the focus differed from meeting to meeting. The first two CoI meetings were designed to create the space and time for the instructors to meet one another, agree on a common inquiry goal, negotiate participation structures in the CoI, and to begin their engagement in individual and shared cycles of action and reflection regarding their teaching practices prior to teaching their focal course in the Fall. Laura and Mike participated through Skype. Three subsequent CoI meetings were designed to continue our process of understanding how the instructors were bringing SRLSPs into their courses, consider how they perceived they were making a difference, and discuss new understandings and questions. In the last meeting Vicky participated via Skype. Table 3.5 summarizes how each CoI meeting unfolded including focus, details, activities, and tools used.

Table 3.5

Community of Inquiry (CoI) Meetings: Guiding Questions, Focus, Details, Activities and Tools

CoI Meeting	Guiding Questions	Focus	Details	Activities and Tools
#1 May	What is going on for us and our students?	Building our community and understanding our task Building a common understanding about SRL	- Getting to know each other - Setting shared goal, processes, roles, and commitment - Researcher introduced SRL teaching and learning framework	Activities: What do you know about SRL? What do you wonder? Collaborative problem-solving Document: Check-out slip[1]
#2 June	What are our goals and plans?	Building a common understanding about SRLSPs in postsecondary settings Streamlining ideas into personal inquiry foci and devising a plan for bringing SRL to the classroom.	- Researcher summarized SRLSPs - Instructors shared struggles their students present and potential factors leading to that - Discussion about instructor responsibility for teaching students how to learn	Activities: What are you doing already that has worked well? What would you like to do differently? Documents: Finding a Focus, Making a Plan Template [2] Check-out slip [1]
#3 September	What have we tried in our teaching in relation to supporting SRL?	Reflecting about on-going teaching in focal courses and sharing with the group.	- SRLSPs in context (What has worked? What hasn't worked? Why? What challenges get in the way of implementation?) - Connections between individual inquiry foci - Student take-up of SRLSPs We identified the need to hear from students.	Documents: Action & Reflection Template [3] Check-out slip [1]

[1] See Appendix C; [2] See Appendix B Part a; [3] See Appendix B Part b

Table 3.5 (Continued)

CoI Meeting	Guiding Questions	Focus	Details	Activities and Tools
#4 November	Are we making a difference?	Understanding whether and how instructors perceived they were making a difference.	- Researcher shared SRLSPs observed across courses - Instructors shared their insights - Researcher proposed a plan for collecting data from students	Documents: Action & Reflection Template [2] Check-out slip [1]
#5 December	What have we learned about SRLSPs? What else do we wonder?	Sharing lessons learned about implementing SRLSPs in undergraduate courses	- SRLSPs that worked and did not work in instructors' focal courses - Contextual limitations and affordances for bringing SRL supports to undergraduate courses	Activity: Think- pair- share Documents: Action & Reflection Template [2] Check-out slip [1]

[1] See Appendix C; [2] See Appendix B Part b

CoI Documents. CoI documents included reflection templates and check-out slips that the instructors completed during the CoI meetings.

Reflection Templates. The reflection templates were self-report documents intended to both support and represent the instructors' action and reflection cycles in relation to their teaching practice. The instructors reported their plans, observations, interpretations, and reflections, as appropriate during the CoI meetings. Two reflection templates were developed (refer to Appendix B): (a) Finding a Focus/Making a Plan; and (b) Record of Actions and Reflections. Data collected through these templates were used to understand the journey of action and reflection each instructor went through in their inquiry.

The Finding a Focus/Making a Plan template was completed once during the second CoI meeting. In this template, the instructors recorded the focus for their inquiry, how they planned to answer their question, and how they would know they were going to be successful.

The Record of Actions and Reflection template was completed three times in CoI meetings number three, four, and five. This template was organized into four quadrants for the instructors to record: (1) the SRLSPs they had tried in their courses; (2) what worked and what did not work as expected and why; (3) their insights and perspectives about supporting SRL in their courses and how their efforts at supporting SRL were influencing their students' learning experience; and (4) their next steps in their inquiry.

Check-Out Slip. At the end of each CoI meeting, the instructors completed a check-out slip (refer to Appendix C) that identified something they were planning to try before our next meeting (e.g., SRLSPs they heard about in the meeting) in addition to something else they wanted to focus on in the following meeting (e.g., impact of SRLSPs in students). The check-out slips were used to understand the instructors' insights about supporting SRL in university courses revealed during the CoI meetings as well as to inform the format and focus of subsequent meetings.

Classroom Observations Processes

I observed in participating classrooms twice during the academic term (October and November) using a classroom observation protocol that captured the dynamic and recursive nature of teaching toward

SRL and the reciprocal influence that learning contexts and learners have on each other (refer to Appendix D). All observations were scheduled in advance with the instructor's consent, occurred in the classrooms where the course was delivered, and the instructor informed students about the researcher's presence in the room. The process of observing in classrooms had three steps: (1) understanding the plan for supporting SRL; (2) observing "what was going on" in class; and (3) debriefing the session. These steps sought to anchor the instructors' thoughts and actions around their teaching practice in real time, understand how the instructors' plans were implemented and how they reflected and/or adapted their plans in response to how students took up the opportunities provided.

Step One. Before observing in their classroom (i.e., the day before or same day), I had a brief conversation in person or via email with each instructor in which they shared their plan to support SRL in that particular session. For example, I asked what their specific goals for supporting SRL were and how they were hoping to accomplish them (see Section A, Appendix D).

Step Two. On the day of the classroom observation, I arrived a few minutes before the beginning of class to find a seat that allowed me to observe all that was going on without distracting students and circulate if appropriate (i.e., towards the back and on the side of the class). During the observation, I kept a running record (i.e., a descriptive and sequential account) of "what was going on*"* in the classroom, paying particular attention to the instructor's use of SRLSPs as well as the students' uptake of these opportunities (see Section B, Appendix D).

Step Three. After the observation (immediately or via-email) I had a brief conversation with the instructors about how what happened in class matched their intentions to support SRL in that session (i.e., things they think worked and things they would change in the future, see Section C, Appendix D). These brief interviews engaged each instructor in action and reflection cycles directly linked to the SRLSPs they had implemented. Further, these interviews allowed me to engage in situated conversations with each instructor to understand SRL supportive practices in the university context. Right after the classroom observation, I coded the running record using a sensitizing lens drawing on conceptual categories from previous research related to supporting SRL (Perry et al., 2018; described in detail in analysis and

interpretation). For reliability purposes, one more researcher was present during the second observation in each course. We both knew what the instructor's goal for supporting SRL was in the class that we visited, and each of us independently kept a running record that we then coded after the session.

Interview Processes

In this section, I describe procedures and tools used to interview participants at the end of the study (December).

Instructor Exit Interview. In-depth semi-structured interviews with all instructors were conducted in the instructors' offices. Interviews lasted about one hour, were audio-recorded, and transcribed. These interviews focused on gathering evidence to understand whether and how instructors perceived: (a) their teaching practices developed/changed across the study; (b) their focus on SRL had helped them to support their students; and (c) their use of SRLSPs in their courses impacted their students' engagement and learning. The interview protocol (refer to Appendix E) was flexible in the sense that not all questions were asked, nor were they asked in the order that they appeared. However, we made sure to address the three topics mentioned above. If needed, I used probes to ask for clarification or elaboration. Some examples of questions asked were: How has your participation in the CoI affected or changed your experience of teaching? What strengths and challenges do you see in the practices associated with supporting SRL for enhancing student engagement and learning in your course? Overall, how do you perceive an SRL approach to teaching your course helped you support your students?

Student Interview. Once the academic term ended and participating students had completed all course requirements, student individual and group interviews took place in meeting rooms provided by CTLT and were scheduled at a time that was mutually convenient**.** Interviews lasted approximately 45 minutes and were audio recorded. Student interviews sought to understand their perspectives about whether and how their instructor's teaching practices allowed them to take control over their learning in the particular course they took. A general protocol was developed (refer to Appendix F) and then tailored to match the course students had taken (Appendix G). Interviews enabled the students to describe how they experienced the SRLSPs in the course they took with a participating instructor.

The interview protocol had two parts. The first part included a few open-ended questions to understand if the students identified SRLSPs as linked to their learning experience in the course. Some sample questions include: (1) "Was your learning experience in this course different to experiences you've had in other courses you've taken at the university? If so, how?"; and (2) "What things in the course helped or didn't help you to be in control of your learning?" If students were short on responses, I probed them mentioning the SRLSPs I observed in visits to their classroom. For example, for one course, I might have asked, "how did you experience being able to choose how to approach worksheets in class?"

The second part of the interview protocol was a brief individual activity. For each course, I prepared chart papers describing specific teaching practices that the instructors implemented with the purpose of supporting SRL. Strategies could be related to specific assignments or activities, how content was delivered, how feedback was given, how the course was structured, student/instructor and student/student interactions in the classroom, domain specific strategies, and dialogue about learning in class. Interviewees were shown the chart paper and were asked to indicate whether: (a) they were aware their instructor used that strategy; (b) they thought the teaching strategy supported them to be active, autonomous learners; and (c) the strategy affected their motivation to learn and the way they approached learning. They then wrote their comments on colored sticky notes and placed them on the appropriate chart with the teaching strategy. We finished by debriefing the activity to clarify and/or elaborate how the practices were or were not helpful.

Analysis and Interpretation

Overview: Evidence and Research Questions

Data analysis attended to each of the research questions. Table 3.6 shows how data were used to inform analysis and interpretation. Given the vast amount of data I gathered, I am not representing all the data to the same extent in my analysis. I relied on CoI documents, classroom observation running records, instructor interviews (brief and in-depth), and course documents as primary sources of evidence. Questionnaires, CoI audio- records, field notes, check-out slips and student interviews were secondary

sources of evidence. These data were used to enrich the primary sources of evidence. In this section, I summarize how collected evidence informed the research questions.

Table 3.6

Evidence and Research Questions

Evidence	Research Questions		
	Q1: SRL supports in undergraduate courses	**Q2/3: Instructors' and students' perspectives about SRL supports**	**Q4: Role of CoI and individual inquiry on advancing teaching practice**
Primary Sources			
CoI reflection templates	✓	✓	✓
Classroom observation running records	✓		
Instructor interviews	✓	✓	✓
Course documents	✓		
Secondary Sources			
CoI field notes and audio-recordings, check-out slips	✓	✓	✓
Questionnaires	✓		✓
Student interviews		✓	

My first research question asked how participating instructors infused opportunities for SRL in their undergraduate courses. I was particularly interested in describing what SRLSPs might look like in undergraduate courses and how instructors shifted their teaching practices to align with a goal of supporting SRL. Course documents collected at the beginning of the study and information collected in the first CoI were a point of reference to understand where the instructors were at the start of the study in terms of implementing supports for SRL in their courses. I relied on CoI reflection templates, classroom observation running records, brief pre/post class interviews, and course documents collected during the

study to capture the instructors' journey of both bringing SRL supports into their courses and then continuing to embed and adapt them throughout the term (these journeys are presented in Chapter 4). In combination, these sources of evidence provided a clear and coherent picture of the instructors' intentions and applications for supporting SRL in their courses over time.

The second research question delved into instructors' perspectives on whether and how the supports for SRL they developed and enacted influenced their students' learning (i.e., engagement in SRL, participation and performance) as well as their perspectives about affordances and constraints to bringing supports for SRL into their undergraduate courses. To address this question, I relied on various sources of evidence. CoI reflection templates and interactions within the CoI (i.e., audio-recordings, notes, check-out slips) were relevant to understanding what the instructors perceived was working for them and their students in their specific contexts and why. These data also offered insights about what instructors perceived were affordances and constraints for the contextualization of SRL supports in undergraduate courses. Brief interviews before and after classroom observations were another source of evidence to anchor the instructors' perceptions in real time in relation to concrete SRLSPs implemented during class time. Exit interviews (held at the end of the study) with the instructors provided insights about their perceptions; these additionally served to supplement other self-report instances and observations during the study. The third research question examined participating students' perspectives about the SRL opportunities they were offered in their courses. Student interviews offered a limited sample of student perspectives. This evidence was used in juxtaposition to what their instructors perceived was going on for the whole group of students enrolled in their courses.

The fourth research question emerged during the study when it became evident that pairing the CoI, as a collaborative structure with and individual inquiry was enabling instructors to mobilize SRL theory and research in their teaching practice. Answers to this question were revealed in the instructors' reflections about the research process. These reflections were recorded on reflection templates, check-out slips, exit interviews, and emerged in discussions held during CoI meetings.

Process

There were two phases of analysis and interpretation. One occurred during data collection and the second one occurred at the end of data collection. Figure 3.5 depicts the analysis and interpretation process.

Figure 3.5

Analysis and Interpretation Process
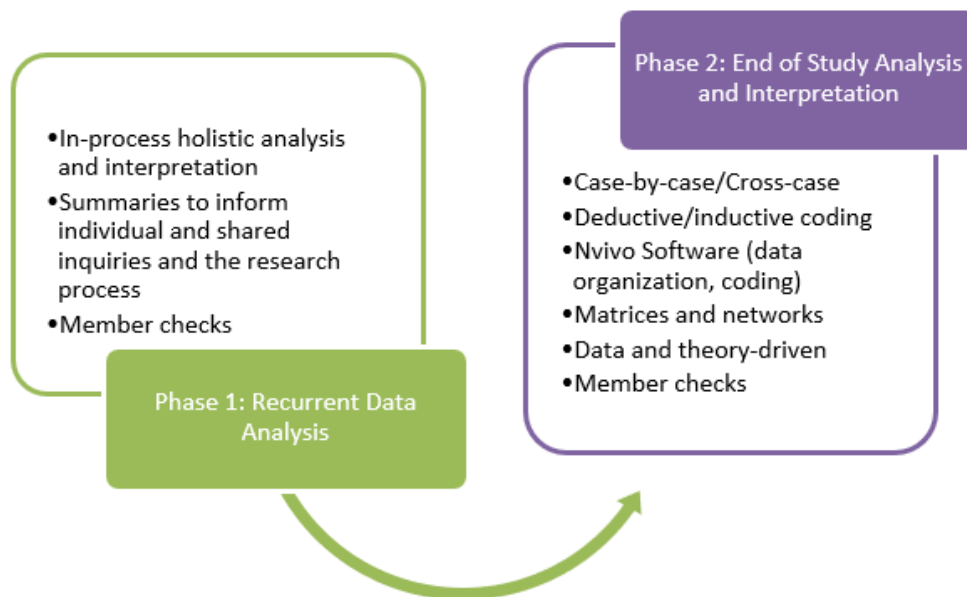
Phase 1: Recurrent Data Analysis and Interpretation. This phase occurred in tandem with data collection. I holistically analyzed the data looking for salient topics, similarities and differences across cases to inform inquiry and research processes (Corbin & Strauss, 2008). In my role as CoI facilitator, I elaborated summaries of relevant topics to share at CoI meetings; these summaries in turn fostered collaborative meaning making and informed the structure and content of subsequent interactions in and beyond CoI meetings (Yin, 2018; Miles et al., 2014). For example, I would address questions instructors brought up in brief individual interviews and in CoI meeting check-out slips. I also shared relevant data (e.g., course characteristics and SRL goals) to contextualize the CoI's inquiry and invite the participants to broaden their understanding of SRL beyond their focal course (refer to Figure 3.6 for examples of how data was shared at CoI meetings).

Figure 3.6

CoI Meeting Slides Examples (September and November)

Likewise, recurrent analysis and interpretation of data informed individual inquiry processes, particularly as a result of brief interviews after classroom observations. For example, based on the classroom observation running records, the instructors and I had conversations that probed their mobilization of theory to practice and vice versa. These conversations nurtured the instructors' individual inquiry and informed subsequent CoI interactions about SRL in context.

Moreover, these analyses also informed the research process itself. For example, during our September CoI meeting, the instructors who were teaching mentioned that it was challenging to assess whether the SRLSPs they were bringing to their courses were having an impact on student engagement in SRL as well as on their participation and performance. Particularly for Laura, Vicky, and Mike whose interactions with students were minimal or short-lived (i.e., during office hours and before/after class). This challenge made these instructors feel the accuracy of their judgments about the impact of their SRL informed instruction was limited. These challenges helped the CoI identify the need to include student voices in the study to both inform the instructors' SRL-focused teaching practice and enrich their perspectives about bringing SRL to their courses. As a result, one instructor incorporated surveys into her course and I proposed running focus groups to hear from the students directly about how the SRL focused teaching was making a difference in their learning experience (i.e., Did they recognize the opportunities to take control of their learning? Did they feel supported to be self-regulating learners?).

Throughout this process of analysis, the instructors were invited to comment on the accuracy of my interpretations and to contribute their own interpretations. These member checks were important to fine-tune my understanding about how the instructors were taking up SRL theory and bringing it to their practice.

Phase 2: End of Study Analysis and Interpretation. This phase of analysis and interpretation was focused on addressing the research questions. It was based on a comprehensive review of the evidence using classic analytic methods in qualitative research; that is, data condensation through the identification of codes and categories, identifying similarities and differences, and theory-driven and data-driven interpretation (Miles et al., 2014). This process enhanced generalizability to other similar contexts.

Data Preparation. Most data were prepared throughout the process of data collection. This involved filing digital documents (i.e., questionnaires, course documents) as well as digitalizing hardcopies of CoI documents (i.e., CoI templates and check-out slips) and classroom observation running records. Audio-recordings (i.e., instructor exit interviews and CoI meetings) were transcribed at the end of the study using an online transcription service (www.trint.com) following a protocol approved by the Behavioural Ethics Board, to which the instructors consented. I did not seek student consent to use the online transcription service, thus I personally transcribed student interviews and typed student data from the individual activity. All data were encrypted and stored in a password-protected computer.

Data Organization. Once all data were text based, I uploaded and organized it in NVivo® by case. In each case, the unit of analysis was an instructor's SRL focused teaching practice situated in the context of their respective undergraduate course. Organizing the data by case enabled case-by-case and cross-case analyses and interpretation.

Data Condensation Through Coding. During a first scan of the data, I used holistic coding methods (Miles et al., 2014) to create broad categories that captured prevalent topics to address each research question (i.e., SRL Supports, instructor perspectives on SRL-focused teaching practice and the research process, student perspectives on SRLSPs). I used these preliminary categories to organize the

evidence. Then, I coded each source of evidence using inductive and deductive coding strategies as appropriate for the different types of data.

Deductive Coding. I coded data from classroom observations, the CoI templates, and provided course documents by drawing on conceptual categories from previous research related classroom supports for SRL as interpreted by Butler et al. (2017). This interpretation was useful because it was created for educators who are wanting to develop self-regulating learners, which fit well with the purpose of my research. Data were coded according to four categories: (a) creating a safe environment; (b) activities (c) instructional support/co-regulation, and (d) assessment and feedback practices. Within each category, I looked at practices through which the instructors could operationalize their supports for SRL (Table 3.7).

Inductive Coding. CoI reflection templates along with audio-recorded transcripts, interviews, questionnaires, and field notes were coded using inductive in-vivo and values coding focusing exclusively on content in the transcripts (Miles et al., 2014). In-vivo coding sought to honour the participants' voices while values coding was used to surface values, attitudes, experiences, and beliefs towards their experience with SRL supports.

As codes emerged through data condensation, I organized them in preliminary thematic subcategories (Figure 3.7). Tables 3.8, 3.9, and 3.10 summarize categories, subcategories and descriptions emerging from inductive coding for instructors and students.

Figure 3.7

Preliminary Categories and Subcategories
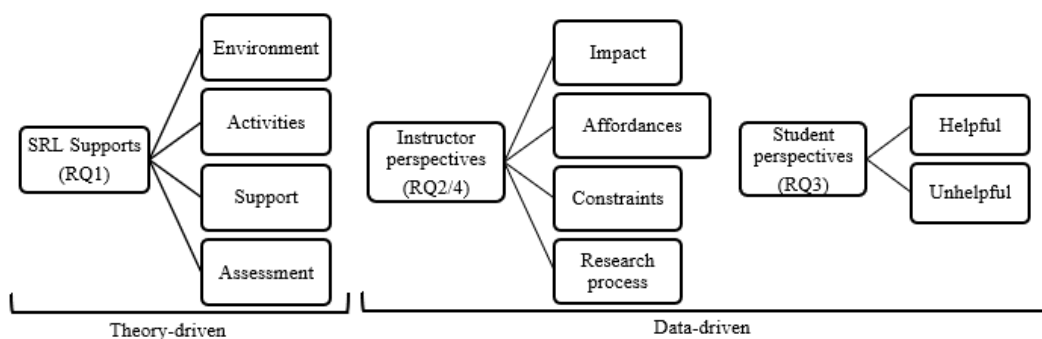
Table 3.7

SRL Supportive Practices: Categories, Subcategories, and Description

Category	Subcategory	Description
Creating a Safe Environment	Fostered a community of learners	Instructors and students are partners in knowledge building. Students' strengths, challenges, interests and needs are valued, recognized, accepted and accommodated. Peer-to-peer collaboration is supported, the classroom is a caring environment, diversity is recognized, big ideas are addressed through inquiry processes (planning, acting, reflecting, communicating, and adapting).
	Positive, non-threatening space for learning	Classroom and teaching/assessment interactions are positive and non-threatening. Mistakes are learning opportunities; students feel in control of their learning over progressively positive outcomes and growth is emphasized (e.g., learning takes effort and time, support seeking is encouraged, formative assessment is used). Motivational messages attribute success to effort and using good strategies, encourage progress and growth, and communicate confidence in students as learners. Students are challenged.
	Participation structures enabled active learning	Expectations (roles, rights and responsibilities) and norms of engagement for different activities are explicitly discussed and/or co-constructed with students and accommodate diversity; predictable routines for participation are established / co-constructed. Instructor is alert to students' experiences and/or supports students in generating strategies for achieving challenging tasks. Different ways of participating are valued.
Activities, Tasks, Assignments	Included multiple instructional goals	Activities involve several goals (e.g., learning content, higher-order goals; using/developing collaborative work skills). The goals should relate to/build on one another
	Were authentic/meaningful	Activities are meaningful for learners (e.g., real-world meaning; inquiry-based, contextualized), integrate content and skills, promote understanding of what it means to think and act like a mathematician, scientist, etc. Engages students in learning/thinking about big ideas. Opportunities to experience challenges.
	Extended over time	Activities are process oriented over time, requiring learners to plan, sequence their thinking and learning processes, and overcome challenges.
	Engaged students in aspects of the cycle of strategic action (SRL)	Students are required to interpret tasks, set goals, identify expectations, plan (i.e., choose and coordinate resources), use strategies adaptively and flexibly (i.e., select, adjust, generate strategies), and/or monitor and refine their approaches (i.e., offer multiple opportunities for self-evaluation of progress, allow students to go through the same task more than once). Engagement in cycles related to different aspects of their performance (cognition, relationships, motivation, emotion).

Table 3.7. (Continued)

Category	Subcategory	Description
Instructional support Co-Regulation	Presented students with opportunities for choice and decision making	Students are offered opportunities to choose and make meaningful decisions (i.e., research topic, resources and learning strategies to use, where to work, who to work with). Choices require students to ponder the demands of tasks, reflect on their learning strengths and challenges and decide on learning approaches.
	Presented students with opportunities to control challenge	Opportunities to control the level of challenge (e.g., oral presentation vs. written exam, learning goals for activities, co-construct performance criteria, involvement in self-assessment, generating feedback for peers). Modifications/adaptations were made by students or negotiated between teacher and students.
	Involved students in individual and/or social forms of learning	Foster both individual and collaborative work. Social forms of learning require students to articulate their ideas, think about themselves and others as learners, and learn with and from others.
	Offered scaffolding	Instructor supports/guides learning through modeling, clear and explicit instructions, strategic questioning. Bridge from guiding learning (structured, systemic, and explicit supports) to encouraging independence (activities are sequenced in ways that support this transition). Students are offered opportunities for reflection on their learning (i.e., the strategies they used and why, how they and others felt about learning, particular subject area skills, values and beliefs about learning, offering opportunities to teach to others). Students are supported to apply knowledge and skills flexibly and creatively (e.g., critical thinking, problem solving). Guided, action or experiential learning is used.
Assessment and Feedback Practices	Included student self-assessment and opportunities to refine/revise strategies and work products	Engages students in self-assessing the quality of their work in progress (according to learning goals) and required next steps/adaptations. Criteria lists and rubrics for students to guide their performance paired with opportunities to talk about these with peers or instructor. Instructor offers opportunities to evaluate or reflect on their work but the substance of the evaluation is meaning related.
	Engaged students in dialogue about learning processes	Directs students' attention to thinking and learning processes while engaged in activities (e.g., strategic questioning, think-pair-share, whole – class discussion). Students are given the opportunity to refine their learning approaches based on information from assessments (by instructors, peers, themselves).
	Provided formative feedback (could be from instructor or peers)	Provides targeted, focused, just in time support and feedback so they can identify and reduce differences between progress and goals. Feedback is descriptive (what's working? What's not working? What's next?) and given in the context of activities. Feedback focuses on the task, causes thinking (students interpret it and use the information to advance their learning, promotes dialogue) and surfaces learning goals (where am I going?). Peers give effective feedback to each other (e.g., discussing their work, peer editing).

Table 3.8

Instructor Insights: Categories, Subcategories, and Description

Category	Subcategory	Description
Impact		Instructor comments and reflections about how the SRLSPs made a difference in student learning experience. Three areas of impact were identified in the data: Meeting SRL goals, participation and performance.
	Meeting SRL Goals	Instances where instructors referred to student take up of SRLSPs and the effectiveness of these practices to meet the goals instructors set for supporting SRL. For example, how students took up choice in one activity and why it was effective or not to meet their goal of fostering metacognitive skills.
	Participation	Instances where instructors referred to indicators of student engagement in class, out of class and assignments. For example, attending class, asking questions, submitting assignments, attending office hours.
	Performance	Instances where instructors referred to indicators of student performance in assignments, midterms, and final projects. For example, grades, content quality, making thinking processes explicit.
Affordances and Constraints		Instructor reflections and comments about factors that they identified as supporting/hindering their teaching for SRL. Three levels of influence were identified in the data: system, student and instructor.
	System	Four subcategories emerged at the system level (structures in place at the institution): Course structure and culture (e.g., multi-section course, content, and outcome-focused courses); time (e.g., short terms and classes); evaluation structures and policies (e.g., imposed structures, round/pass grades); and technology (e.g., learning management systems).
	Student	One category emerged at the student level: Paradigm shift. It involved instructor perceptions of student attitudes, behaviours and beliefs.
	Instructor	Two subcategories emerged at the instructor level: Competence (e.g., perceived knowledge about SRL, lack of follow through with plans) and beliefs about teaching and learning (e.g., responsibility around teaching how to learn, lack of control over classroom culture).

Table 3.9

Student Insights: Categories, Subcategories and Descriptions

Category	Subcategory	Description
Experience with SRLSPs		Student comments and reflections about specific SRLSPs that instructors implemented in their practice. Students reflected about whether and why these practices were effective or ineffective to take control over their learning.
	Effective practices	Instances where students referred to specific SRLSPs as effective to engage them in strategic and metacognitive learning according to the instructional and SRL goals instructors set for them. Includes instances when students refer to transfer of strategies. For example, students' thoughts about scaffolding as helpful to identify the steps in the process and demonstrate their thinking.
	Ineffective practices	Instances where students referred to specific SRLSPs as ineffective to engage them in strategic and metacognitive learning according to the instructional and SRL goals instructors set for them. For example, student's thoughts about reflection as irrelevant when there are no more opportunities to apply what's learned through them.

Table 3.10

CoI Structure and Inquiry: Categories and Description

	Category	Description
CoI structure and inquiry	Productive	Instances where instructors expressed their participation in the CoI and engagement in inquiry supported them to set and follow through their plans and remain accountable in their deliberate and focused practice. Includes qualities of CoI structure (organization, atmosphere, support) and inquiry (iterative).
	Validating	Instances where instructors expressed the CoI, as a structure, and inquiry as a process, served as a reassuring forum/space to feel validated in their practice, ideas and struggles.
	Transformative	Instances where instructors expressed that their participation in the CoI and engagement in inquiry was transformative for their practice and understanding of teaching and learning at the university. Includes shifts to teaching process, perspectives about students and instructor's role, and competence.

Theory and Data-Driven Analyses and Interpretation. Following Yin's (2018) suggestions on multiple-case study data analysis and interpretation, I first analyzed and interpreted cases individually (i.e., instructors teaching a course) by identifying the evidence that addressed the research questions for each case. Given the nature of the research questions, I used SRL theory to drive the analysis of the first question (How did participating instructors infuse opportunities for SRL in their undergraduate courses?). I then used data to drive the analysis of the second (How did instructors perceive supporting SRL in their undergraduate courses?), third (How did students experience the SRL opportunities offered in their courses?), and fourth (What role did a Community of Inquiry (CoI), as a collaborative structure, and individual inquiry, as a process, play in helping this group of instructors translate and mobilize SRL research in their practice?) questions. Afterward, I engaged in cross-case comparisons using case- and variable-oriented strategies (Miles et al., 2014). For instance, I followed a replication strategy whereby I identified patterns in one case (i.e., Laura) and looked for pattern matches across cases when I addressed the first research question (Yin, 2018). For the second, third and fourth research questions I looked for recurring themes across cases (Miles et al., 2014).

I used matrices to facilitate the interpretation of evidence (Miles et al., 2014); in other words, I synthesized patterns and differences across cases to create conceptually clustered matrices (Butler, 2011; Miles et al., 2014). Figure 3.8 depicts the process of analysis and interpretation using these matrices for the first research question. In the first step, I completed a matrix template for each SRLSPs category (e.g., instructional supports) by inserting coded passages for subcategories (e.g., choice, control over challenge) and keeping the data linked to cases. I then annotated these entries with interpretations signaling patterns and differences across cases following a replication logic. Finally, I used these interpretations to build cross-case, conceptually clustered matrices (e.g., across categories or according to SRL components).

Figure 3.8

Matrix Templates Used to Analyze and Interpret Evidence for Research Question 1

SRLSPs Matrix Template (one per category)
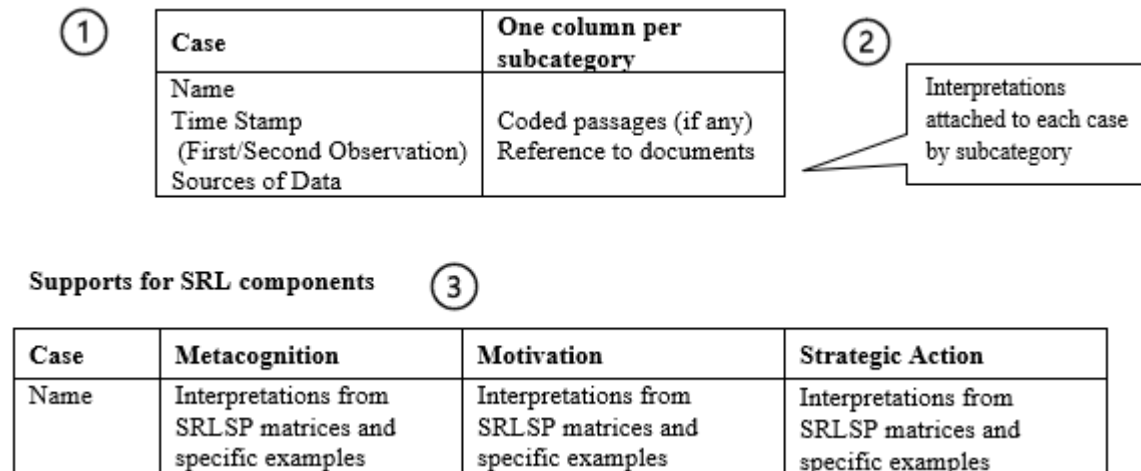
Likewise, I used matrices describing instructor and student insights to address the second, third, and fourth research questions, which I was able to refine through iterative cycles of interpretation. I created a first matrix by using the broad categories identified as prevalent topics in a holistic analysis (i.e., for instructors: impact, affordances, constraints, research process; for students: helpful and unhelpful) which helped me identify subcategories within those broad categories. Then I created a matrix by case for these subcategories in order to identify the nuances within each of them and compare/contrast across cases. This process resulted in refined subcategories that were grouped as conceptually clustered networks (Miles et al., 2014). As a result, I identified final categories representing the instructors' insights (e.g., the system level of influence that the instructors identified as affording and/or constraining them to bringing SRL supports to undergraduate courses). Figure 3.9 exemplifies this process of analysis and interpretation of evidence using matrices and conceptually clustered networks.

Figure 3.9

Process of Analysis and Interpretation for Research Question 2
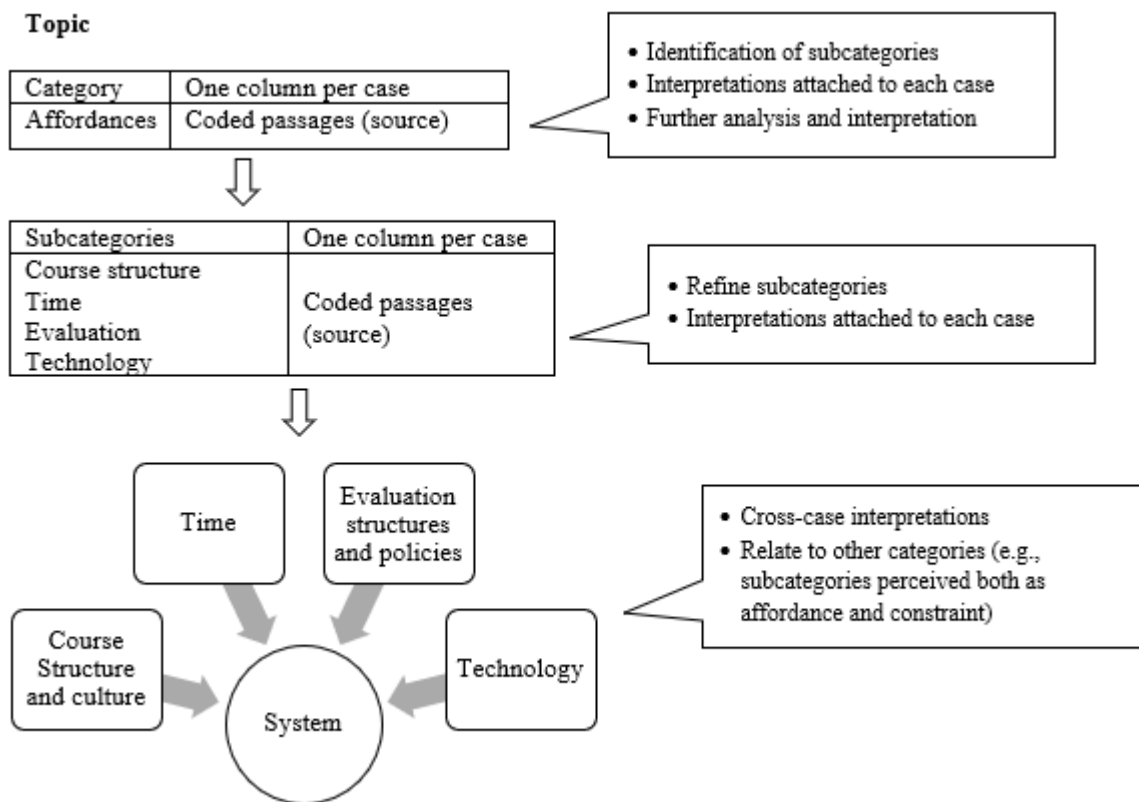
As I constructed case interpretations, I shared them with the instructors and invited them to express whether they perceived the interpretations to be accurate and complete. All instructors responded positively with clarifications during Phase 1 of analysis and interpretation, and with a few comments (e.g., transcription typos, current efforts at supporting SRL) and reactions (e.g., expressions of interest in the cross-case findings, feelings about student comments) in Phase 2. I present a case-by-case description of the instructors' implementation of SRLSPs in Chapter 4, and cross-case analysis for each of the research questions in Chapters 5, 6, and 7.

Overall, the approach to data collection, analysis and interpretation taken in this study considered the complexity and multi-determined nature of teaching towards SRL and life-long learning. This study supports naturalistic generalization because it provides a rich and comprehensive picture of efforts to

translate theory into practice in authentic settings, as well as instructor and student perspectives about contextualizing supports for SRL.

Trustworthiness

In this section, I share how I thought about the relevant threats to the validity of my study and addressed them to ensure trustworthiness (Berger, 2015; Saldaña & Omasta, 2017). I highlight potential barriers and biases related to using SRL as a sensitizing lens and elaborate on the value of using triangulation methods along with inquiry-based and participatory approaches to research to increase/enhance the rigor and trustworthiness of my study.

I purposefully used a sensitizing lens (SRL) to guide the research process, data analysis, and interpretation. While using this lens might have posed a barrier to examining other approaches to teaching and learning as the study progressed, the contextualized and individualized nature of the design and research process offered a shared focus and, perhaps, enabled the development of a shared language to support conversations in the CoI. Throughout our meetings, the instructors recognized an overlap between their teaching beliefs and practices and the SRL framework. Interestingly, as the study progressed, the instructors transitioned to engaging with the theoretical lens more holistically rather than embracing it in a fragmented way. Notwithstanding, throughout the research process I remained vigilant to evidence that challenged and extended the sensitizing lens I brought to my study (Saldaña & Omasta, 2017).

Using participatory research processes highlighted the value I, as an educational researcher, place on the expertise of educators' situated teaching practice to advance understandings about SRL as well as to bridge research to practice (Crotty, 1998; Creswell & Creswell, 2018; Stringer, 2004). Thus, the exploratory and socially constructed nature of the study invited the participants to feel safe and valued as collaborators in the process of knowledge making about supporting SRL in undergraduate courses. To illustrate this point, I borrow Peter's words in the exit interview: "You had your research questions but it also was really intended to be an exploration for the participants as well, so we were also driving it in a sense." Likewise, a main aspect of the study focused on understanding the instructors' perspectives on whether and how implementing SRLSPs worked or did not work in their contexts. This focus stressed the

emphasis on exploring the individual and collective meaning made in the process of inquiring about teaching for SRL. Partnering with the instructors over a long period of time was positive to build trust and engage in genuine, productive, and transformative collaboration.

When I put on my participant-observer hat, it was easy to bring a personal and theoretical bias favouring SRLSPs in my observations. With this threat to validity in mind I invited a fellow graduate student with knowledge of SRL and experience using classroom observation protocols to act as second observer in one of the two observation sessions. The second observer did not have a relationship with any of the instructors and was not personally invested in my research. While their knowledge of SRL might have favoured SRLSPs in their observations, it was also useful not to miss important cues in the instructors' practice. We coded the observation protocol independently and soon after the observation (same or following day) we met to seek "coding consensus" (Bradley et al., 2007) by comparing our coding and discussing our discrepancies until we reached 100% agreement.

The instructors and I shared an affiliation to the academic community as well as the experience of conducting dissertation research. The fact that I was facilitating a process that I designed for the purposes of meeting a doctoral degree requirement, something that the instructors were fully aware of, could have stopped them from challenging the model of inquiry or tools (e.g., record of actions and reflection template) that I was using to guide our work together. Nevertheless, the iterative and reflective nature of the research process, combined with the check-out slips and informal member-checking instances (i.e., via email or after CoI meetings), invited the participants to voice their suggestions and perspectives. Their insights shaped the research process (e.g., data collection, content in and number of CoI meetings) and ensured that their perspectives were well represented in my descriptions (Miles et al., 2014; Yin, 2018). Moreover, the inquiry process that I presented to the instructors (i.e., critical application of theory to their teaching practice as they engaged in cycles of action and reflection) resonated with them. At least two members of the CoI expressed in the recruitment interviews that this characteristic of the study motivated them to participate. In member-checking exchanges during data analysis and interpretation, the instructors highlighted their continued efforts at critically looking at their own teaching through an SRL lens. These

revelations lead me to believe they genuinely valued the processes that I facilitated in our CoI and the study more broadly, further suggesting that their contributions were authentic.

I relied on triangulation strategies and member checks to generate trustworthy evidence and corroborate my descriptions in addressing the research questions (Miles et al., 2014; Yin, 2018). Collecting multiple types of evidence from different sources in naturalistic settings over time was a methodological triangulation strategy (e.g., CoI documents were used to understand the journey of action and reflection for each instructor and these data were triangulated with data collected in classroom observations and course documents). Given the nature of the measures I used in my study, I expected to have absences in the data. For example, I might have not observed an instructor providing specific SRL opportunities because it was not their focus, but it did not mean they did not provide them or reflected on these opportunities outside of our conversations. The iterative nature of the research process, member checking and triangulation of data enabled me to obtain a comprehensive picture of the instructors' SRL focused teaching practice.

As warranted in the literature, interpreting the relationships amongst various variables was messy, time consuming, and, at times overwhelming (Butler, 2011; Butler & Cartier, 2018; Winne & Perry, 2000). For this reason, I drew on Mathison's (1988) conceptualization of triangulation of data in which meaningful explanations of the problem of study were constructed through the combination of convergent, inconsistent, and contradictory evidence.

In sum, throughout my involvement in this research, I continually monitored the potential influence of my beliefs, assumptions, and biases and actively sought strategies to counteract them (i.e., prolonged engagement with participants, repeated interviews with instructors, member checking, triangulation, and peer review; Berger, 2015) in order to secure the research's trustworthiness and credibility.

Chapter Four: Situated SRL-Focused Teaching Journeys

In this chapter, I present each instructor's SRL-focused teaching practice journey which will contextualize the cross-case research findings presented in subsequent chapters. These journeys occurred in the context of undergraduate courses and reveal the iterative cycles of planning, enacting, reflecting, and adjusting each instructor went through to bring SRL to life in their course. For four instructors (Laura, Dana, Mike, and Vicky), the journey/inquiry took place in a course they were teaching for the duration of the study, whereas one instructor (Peter) based his inquiry on a course he had recently taught because he was not actively teaching at the time the CoI was meeting. I drew on CoI and course documents, classroom observations, and questionnaires to create these journeys.

The Context: Undergraduate Courses

The courses that served as context for the instructors' inquiry in this study followed a traditional lecture teaching model: sessions were held two to three times per week, during which time the instructors covered content and facilitated activities, sometimes with technology supports (e.g., slides, document cameras), while students took notes or engaged with suggested activities. The participants in this study infused this traditional model of lecturing with SRL-focused teaching practices to empower their students to be agents of their own learning. All of the courses had similar requirements, such as weekly homework assignments, scheduled in-class quizzes, midterms, and a final exam. In terms of resources available for students, all courses used a web platform through which students could access class materials, instructors' notes and slides, and assignments. Students could also reach their instructor either during scheduled office hours or upon request. The courses varied in terms of subject matter, level of instruction (i.e., introductory, intermediate, advanced), number/duration of weekly sessions and class size (see Table 4.1).

The instructors' autonomy over the course design varied according to the course level and structure. The instructors who taught introductory (i.e., Laura and Vicky) and intermediate (i.e., Mike and Peter) courses with multiple sections participated in course planning meetings with colleagues where common organizational structures (e.g., course outline, schedule, content, evaluation tasks and procedures) were negotiated. On the other hand, in the advanced course, Dana had full autonomy over

Table 4.1

Characteristics of Each Undergraduate Course

Instructor	Subject Matter	Features	Enrolled Students
Laura	Differential Calculus for Life Sciences	Introductory multi-section course 3 sessions/week (50 min. each)	404 (2 sections)
Dana	Developmental Genetics	Advanced (elective) 3 sessions/week (50 min. each)	35
Mike	Math Proofs	Intermediate multi-section course 3 sessions/week (50 min. each)	65
Vicky	Computer Programming	Introductory multi-section course 2 sessions/week (90 min. each)	92
Peter	Calculus	Intermediate multi-section course 3 sessions/week (50 min. each)	145

designing her course. Depending on the class size, classes met in large lecture halls (i.e., Laura's, Vicky's, and Peter's), large classrooms (i.e., Mike's), or small classrooms (i.e., Dana's). Class size also determined the instructors' involvement in evaluation and feedback; for instance, in larger classes (Laura's, Mike's, Vicky's, and Peter's), teaching assistants graded weekly assignments and quizzes and reported back to instructors on how students were doing. These instructors had hands-on grading experience in midterms and finals. However, they graded exams from students across sections instead of exclusively focusing on the exams of students enrolled in their section. On the other hand, Dana evaluated and graded all of her students.

Inquiry on SRL-Focused Teaching

The design of the study invited the instructors to engage in individual and shared cycles of action and reflection (inquiry) about their SRL-focused teaching practice throughout an academic term. The instructors translated their understandings of SRL as a teaching and learning framework into opportunities for students to engage in SRL in their courses. The SRL-focused teaching inquiry began with a planning phase prior to the Fall academic term when the instructors set an overarching goal for the term and identified instructional strategies to accomplish that goal. Then, as they taught their course, the instructors

tried out different SRL supportive practices (SRLSPs). Throughout the course, they engaged in a process of observation and reflection as to what appeared to be going on for their students in relation to the various SRL supports they brought to class. The instructors based these reflections on the following: informal observations they made during class time; recollections from interactions with students outside of class; students' performance on assignments and exams; results from tools they designed for this purpose (one instructor surveyed her students); and/or comparisons to other cohorts of students they taught in the past. The instructors then discussed these impressions with one another at CoI meetings and with me during classroom observation debriefs and exit interviews. This individual process, along with discussions we held as a CoI, continued to shape the instructors' teaching practice and engaged them in new cycles of planning, enacting, reflecting, and adjusting. During data collection, I documented three full individual cycles of action and reflection for all instructors except Peter (two cycles). However, it is possible that they might have engaged in additional cycles that I did not observe as they were implementing and reflecting upon their practice.

What Knowledge and Experience Did Instructors Bring to the Study?

This group of instructors was deeply committed to improving university teaching and learning generally. As well, they had personal motives to improve their teaching, research, and/or professional practices. While all the instructors had taken part in prior initiatives related to teaching and learning innovations and some had informally engaged in inquiry, none of them had participated in collaborative inquiry or anything like a CoI.

Above all, the focus on teaching students "the skills to learn by themselves—to become life-long learners" (Vicky, September CoI meeting) appealed to the group. They welcomed the opportunity to, through their teaching, educate students to be critical thinkers who could adapt their expertise to contextual demands. For example, Vicky commented: "[Students] will leave the university and if they don't know how to learn in Computer Science, they won't keep up with the field. You have to re-learn new technology and new practices every year, that's a big thing for me" (September CoI meeting). Thus, they saw the focus on SRL and also the process of inquiry, as a professional development opportunity; as

such, they were open to seeing their practice through an SRL lens, to inform their teaching and enhance their students' learning experience.

At the outset of the study, the instructors were at different places in relation to their understanding of SRL. In the first CoI meeting, I asked the instructors to write down what they knew about SRL. Peter mentioned he had "spent a lot of time learning about effective teaching methods from an evidenced-based point of view but had read very little under the name [SRL]." However, some aspects of SRL (i.e., metacognition and strategic action) resonated with ideas he had heard about the development of study skills and "expert-like" habits. Dana extended the association between metacognition and expertise, saying that experts are self-regulated and "have a good grasp of what they know, don't know, and want to know … Also, they have appropriate/effective responses to not understanding something—adopting good learning practices." Vicky emphasized the instructor's role in fostering SRL. She said: "SRL relates to providing students with various ways to interact with the content they are learning and encouraging students to reflect on their learning strategies." She elaborated further by adding that student agency is a key part of SRL: "Approaches and time spent studying are very much controlled by the student." Laura also focused on supports for SRL, mentioning these were "related to encouraging students to work hard while helping them along." Mike did not share his understanding of SRL at the beginning of the study. Despite sharing these relevant ideas about SRL, the instructors mentioned they did not have formal knowledge about SRL.

In relation to their prior teaching experience, the instructors mentioned in the first CoI meeting that they had not deliberately taught to foster SRL. Nevertheless, descriptions of their general teaching approach recorded in questionnaires showed these instructors were already using some SRL supportive practices unknowingly (e.g., co-constructing knowledge, guiding through questions, involving students in individual and social forms of learning). Moreover, Peter, Dana, and Vicky acknowledged having experience with teaching methods like flipped classroom model and project/problem-based learning which align with SRL supportive principles.

In addition to seeing the study as an opportunity to enhance their pedagogical knowledge and advance their teaching practice, instructors like Laura and Peter saw the study as an opportunity to expand their research experience and professional practice. For example, in our June CoI meeting, Laura said: "I've been hoping to work more with people in education [be]cause my background is in mathematics and I don't know much about doing research in education ... I saw [the study] as an opportunity to expand my repertoire." For Peter, whose work relates to faculty development, the research design and process (collaborative/individual inquiry) was of interest.

Once the instructors were part of the CoI, they were eager to share their perspectives and embraced the process of inquiry with enthusiasm and curiosity. Each instructor both contributed their discipline-specific teaching expertise to the group and positioned themselves as learners in relation to their colleagues' expertise. For example, in our June CoI meeting Laura expressed:

> "I have two big questions about [bringing SRLSPs to my courses]. First, I feel I don't
> know what I don't know about the most up-to-date scholarship of teaching and learning
> … I'm worried that I'd be providing students with a scattered array of tidbits, and
> possibly missing a larger picture. Second, I don't know what students already know
> about this. I had never heard of *growth mindset* when I was their age, but times have
> changed."

The instructors' motives for joining the study included a curiosity about SRL as well as willingness to learn from and with their colleagues (including myself) and seek inspiration to think critically about their own teaching practice.

SRL-Focused Teaching Journeys

Laura

Laura chose a multi-section introductory course on Differential Calculus as the context for her SRL-focused teaching inquiry. She was teaching this course for the first time; there were 404 first year students enrolled in the two sections she taught. The class met three times a week (Monday, Wednesday, Friday) with each session lasting 50 minutes. Laura shared the structure of activities for each week with

her students through the learning management system; the information she shared included the content to be covered, available resources, as well as the type, purpose, and due dates for each assignment. This course differed from other undergraduate calculus courses offered at the university in that it applied to the life sciences (i.e., biochemistry, cell biology, ecology, and genetics) rather than to physics. This focus meant it was not necessary for students to have a strong background in calculus as a prerequisite to enroll. Since sections were large (~ 200 students), the course relied heavily on the web platform as a forum for students to seek and offer peer support, communicate with their instructor, submit assignments, and access resources.

From Lecturing to Guiding Problem Solving. Laura's goal was to encourage her students to become active in their own education; accordingly, she sought to foster metacognitive knowledge and skills, as well as strategic action in her students. Laura initiated her journey by adding an SRL supportive feature to her lecture. However, as the term unfolded, she integrated SRLSPs throughout the course. Figure 4.1 depicts her journey of action and reflection on SRL focused teaching practice.

The First Cycle: Lecturing. At the beginning of the term, Laura focused on disseminating information about SRL to her students and being explicit about tasks, activities, and class structure. She introduced a 5-minute metacognitive segment at the start of Monday's sessions in which she planned to briefly lecture about SRL (i.e., What is metacognition?) and offer her students a rationale about the tasks for the week. On one occasion, Laura explained why she was first lecturing about content and why a specific assignment was useful to advance their learning. However, she found it difficult to gauge the quantity and quality of information she needed to provide her students for them to engage in metacognitive thinking. Thus, she dropped the metacognitive segments and decided to contextualize her supports for metacognition and strategic action in mathematical problem solving, a skill her students were expected to develop in the course.

Continuing with her lecturing approach, on one occasion Laura gave a mini lesson on the importance of problem analysis and planning by showing her students the steps to solve a difficult problem. She shared a research study ("Learning to think mathematically", Schoenfeld, 2016) that

Figure 4.1

Laura's SRL-Focused Teaching Journey: Cycles of Action and Reflection Across One Academic Term[3]

Planning (June)
Goal: Support student metacognitive knowledge and skills
Strategies: Talk about SRL, explicit class-task structure

Adjusting
Reinforce/ model problem solving
Foster metacognition and growth mindset in class,
quizzes, and assignments

Enacting
Lecturing about the
importance of
problem analysis and
solving ('Learning to
think
Mathematically').

Reflecting
*"Wish [activity] was
more interactive ...
hard to judge student
response."*

September
Lecturing

Adjusting
Foster metacognition using a different
strategy in class

Enacting
Modeled and
demonstrated problem
analysis and solving

Reflection questions on
quizzes/assignments

Reflecting
"Demonstrating [problem
solving] *doesn't seem to
change practice overall."*

October-November
Modeling and Reflection

Adjusting
Collaborate with other instructors to
foster metacognition across classes

Enacting
In-class guided practice
through metacognitive
questioning and
meaningful choice

Reflecting
*"Metacognitive skills take
a long time to develop ...
one-on-one questioning
was effective."*

December
Guided Practice

---

[3] During member checks, I shared with each instructor the illustrations I created to represent them. I asked them whether they felt represented and whether they preferred I used a different illustration or no illustrations. All instructors approved the illustrations I presented to them.

emphasized how experts spend more time interpreting the problem and monitoring their progress to a solution than on performing computations when they solve mathematical problems, whereas novices spend more time performing computations. That same day, Laura presented her students with difficult problems and expected them to be strategic in their approach to solving the problems (i.e., following the model she had just presented). In reflecting about this in-class activity she expressed, "I wish it was more interactive and I could better judge students' response" (September CoI reflection template). When adjusting her strategies to continue bringing opportunities for SRL into her teaching, Laura planned to integrate metacognition and growth mindset across her lectures, quizzes, and assignments.

The Second Cycle: Modeling and Reflection. In subsequent lectures (October-November) Laura modeled problem analysis and solving and offered her students opportunities to approach difficult problems. During the lecture, she introduced the topic using a slide presentation and then gave her students applied problems to practice problem solving skills using the content they had just learned. She fostered peer-to-peer collaboration and student contributions were valued. The students worked at their own pace, either individually or in small groups, and chose different methods to solve problems while Laura walked around the lecture hall offering individual feedback and debriefing with the whole classroom regularly. For example, she addressed the class for clarification when she was asked the same question twice: "I didn't tell you where to start, where to end. General rule of thumb is if you're getting numbers that are similar to each other, it means you're getting close to the root" (classroom observation 1).

She engaged her students through questioning (e.g., Can anyone tell me what equation I should set up?) and demonstrating effective ways for approaching difficult problems. Over these weeks, Laura motivated her students to think about themselves as learners beyond classroom time and included a reflection question in quizzes for bonus points (i.e., Which of the previous questions did you get completely right?). Reflecting on these actions Laura noticed her students "had a hard time thinking how to approach the problems although I saw some interesting set ups … (classroom observation 1 debrief); [modeling and demonstrating problem solving] helps their understanding but that hasn't yet jumped into

them doing it in their own practice" (November CoI meeting). Going forward, Laura thought she would put more emphasis on the value of using multiple paths to arrive at a solution, as well as on learning from errors. To accomplish the latter, Laura added a reflection question to one of her graded assignments inviting students to analyze their midterm performance, identify the type of errors they had made, and devise strategies to improve in those areas (Figure 4.2). When adjusting her plan, Laura committed to changing her strategy during lecture time and other activities to continue enhancing her students' metacognitive knowledge and strategic problem solving.

Figure 4.2

Learning from Errors - Reflection Question in Laura's Graded Assignment

This question will deal with the aftermath of the midterm. It is extremely important for you to identify and address your mistakes on the midterm before they hinder your further performance in the course. Download the solutions from the Midterm information page. For each question you got wrong, carefully go through it and characterize each, and every, mistake you made as:

A: **A**lgebra or **A**rithmetic error
B: not knowing how to **B**egin the problem, not understanding what the question is asking for
C: not understanding a **C**oncept or how to apply it in this context (specify symbolic, graphic, or geometric)
D: **D**istracted or careless mistake (rushed)
E: other reasons (please specify)

Create a list of errors you've made for every question. What types of errors are you prone to? What is your strategy to improve in these areas? You do not need to hand in a reworked and corrected version of your answers. You should just hand in a summary of your errors/issues and describe your strategy for avoiding them in the future.

The Third Cycle: Guided Practice. At the end of the term (December), Laura engaged her students in guided practice during class time. She designed a worksheet (Figure 4.3 depicts instructions to complete the worksheet) that offered students meaningful choices to work on problem solving skills and required them to be metacognitive and strategic. Laura sought to make the task valuable for her students and explained she was not giving them an answer sheet because in 'real-life' situations (e.g., exams, assignments, work) solutions are not given but students must know how to verify their answers.

Laura structured lecture time to be an opportunity for her students to work at their own pace, either individually or in small groups, and seek help when needed. She circulated around the lecture hall and guided individual students and small groups with metacognitive questioning and dialoguing about

Figure 4.3

Laura's Guided Worksheet Instructions

> **In- class Worksheet: Working on problem solving skills.**
> The problems are not meant to be worked in order, pick and choose what is useful to you! The point is planning an approach, not the solutions. In particular how to verify your answers, verify if your problem makes sense and how many ways can you figure out to solve it.
>
> 3 possible sections:
> - Review content – opportunity to practice recent topics
> - Analyze, plan, implement, verify- practice planning approach and/or verifying your final answer
> - Apply old concepts to new situations – to master a concept practice applying it in unfamiliar situations
>
> *"Before you raise your hand for help, analyze what the problem is saying; plan an approach; think about how to verify your answer; think about content to review; ask your peers. I'll be circulating to answer questions."*

what and how they were approaching the problems. Reflecting on this activity, Laura decided she would adjust it by making the task goals clearer (both prior to and when introducing it) as well as shorten it so students could focus on harder problems rather than shopping around for easier ones. She thought: "The choice of problems didn't have much impact. Despite my advice, most worked linearly down the worksheet … the one-on-one questioning was the most effective part … these metacognitive skills take a long time to develop" (classroom observation 2 debrief). Moving forward, Laura said she wanted to find ways to collaborate with other instructors, continue developing metacognitive skills across classes and "have clearer goals to push during the semester" (December CoI meeting check-out slip).

Dana

An advanced elective biology course (Developmental Genetics) was the context in which Dana focused her inquiry about teaching towards SRL. Prior to the study she had taught this course eight times on an annual basis and had polished her syllabus and course structure over time, so that students not only learned the content but also "developed the ability to think and 'function' like a successful and thoughtful scientist" in the field (syllabus). Thirty-five students in the fourth or fifth year of their program were enrolled in the course. These students had diverse experience including course-based and paid experiential learning through a co-op program in the Faculty, lab, and/or research experience. The class

met three times a week (Monday, Wednesday, Friday) in 50-minute sessions. Dana implemented variations to the traditional undergraduate course requirements (e.g., two midterms and final project and individual electronic portfolio instead of a final exam).

SRL as an Instructional Goal. Dana designed her course with the goal of developing and/or enhancing SRL. Thus, from the beginning of the course, SRLSPs were woven into tasks and activities. Figure 4.4 depicts Dana's journey of action and reflection about her SRL-focused teaching practice.

The First Cycle: Introducing SRL. At the beginning of the academic term, Dana's goal was to make SRL explicit throughout her course. She was particularly interested in fostering strategic action through assignments and in-class tasks and activities, as well as metacognitive skills through self-assessment. She also wanted to explore how to infuse SRL in collaborative work both in and beyond class. To crystalize her goals, Dana included information about SRL dimensions (i.e., motivation, strategic action and metacognition) in the first lecture as well as the course syllabus by connecting this information to learning in her course and working as a scientist. In addition, Dana also designed graded planning and reflection assignments or added questions to content-related assignments for students to briefly review/reflect on various course activities and/or engage them in strategic action (Figure 4.5).

Reflecting on these activities, Dana mentioned: "Students didn't rebel, and two students made explicit reference to SRL during a conversation. One of them asked to learn more about SRL" (September CoI reflection template). However, she thought she would need to further support her students in their judgements of progress and success, both in specific tasks and within the course in general, and find out from them how the SRL assignments helped, hindered, or had no effect on their progression in the course. Dana wanted to remain attentive to how her students reacted to SRL related activities and if they mentioned SRL unprompted.

Figure 4.4

Dana's SRL-Focused Teaching Journey: Cycles of Action and Reflection Across One Academic Term

Planning (June)
Goal: Make SRL explicit throughout the course; engage students in strategic action and metacognitive thinking.
Strategies: Clear expectations, planning and reflection in assignments, formative self-assessment

Adjusting
Give students strategies for self-assessment
Survey students about influence of SRL
assignments on progress

Enacting
Talked about SRL in
lecture, designed short
SRL assignments

Reflecting
*"Students didn't rebel,
some students seemed
interested in SRL."*

September
Introducing SRL

Adjusting
Ask students to reflect about their
approach to engaging in different
activities

Enacting
Fostered student
growth mindset and
engagement in strategic
action in and beyond
class. Surveyed
students about progress
in relation to SRL
assignments

Reflecting
*"The fact that some
students now refer to SRL
in their reflections and
even ask questions about it,
means that for them
something is taking."*

October-November
**Fostering strategic action and a
growth mindset**

Adjusting
Add specific SRL learning goals
next year, redesign course
activities.

Enacting
Engaged students in
strategic action in
collaborative work,
research, exam
writing, and
assignment
preparation.
Surveyed them
on tools used to
support them on
the final project.

Reflecting
*"Some students opened up
about their struggles,
strategies, failures… a
really nice atmosphere
built up in class."*

December
SRL in authentic tasks

99

Figure 4.5

Dana's Planning and Reflection Assignments

R&R # 1 (SRL assignment)
1. In a few days you will need to submit a draft of your research question for the final project. How did/will you go about developing this question?
2. What do you expect to be challenging about this task?
3. Think about evaluation criteria for your draft research question assignment. If your instructor were to mark your draft question, what do you think she should be looking for? What makes a top-level draft research question assignment?

Case-study Group Work (Content assignment)
Question 7. Think about the experience that you just had of working collaboratively on an assignment. As a group, how did you proceed? Was the strategy successful? How did you define "successful"? If you were to work together again, would you do anything differently?

The Second Cycle: Fostering Strategic Action and a Growth Mindset. During October and November, Dana fostered student engagement in cycles of strategic action and promoted a growth mindset in her students. During class, she presented her students with topic-related problems and explicitly invited them to collaborate in small groups as they focused on task understanding (e.g., What do you know already about this topic? What do you wonder? What are you being asked to do?), and on generating different approaches to solve the problems. Dana offered support to the small groups through questioning, dialoguing about their approaches, and feedback; she also debriefed with the whole group on a regular basis. She valued student contributions and linked them to course activities (e.g., "… that has not been shown, it's a very good question! It could be a project question", classroom observation 1). In terms of assignments, Dana re-designed one of her SRL assignments to engage her students in self-assessment about their progress in the course (Figure 4.6). She fostered a growth mindset in her students by emphasizing that their efforts in self-evaluating their progress and identifying productive strategies would likely lead to improvement.

When reflecting about these activities, Dana mentioned: "The fact that some students now refer to SRL in their reflections, and even ask questions about it, means that for them something is taking … some students need time to act on their 'resolutions and time to fail to act on them, and this doesn't mean they are not trying – it takes them time to act successfully'" (November CoI reflection template). As for

her in-class experience, she thought that it was important to find the balance between topic-related

challenges and opportunities for them to explicitly engage in SRL. Going forward, she wanted to focus on

modeling and engaging students in strategic approaches to collaborative work, along with self-

observation about how they approached stressful (e.g., exams) versus non-consequential situations.

Figure 4.6

Dana's Self-Assessment Assignment

R&R # 3
For this R&R assignment you will have the (somewhat daunting) task of assessing your progress in *one* aspect of the course (e.g., your understanding of the material, the way you "view" gene regulation, your final project, some skill that you feel you are working on, etc.).
Focusing on your selected aspect, please answer the following questions:
    1. How would you describe your progress so far?
    2. Are you satisfied with your progress so far?
    3. What evidence/pieces of evidence did you use to determine whether you have made progress?

The Third Cycle: SRL in Authentic Activities. In the last month of the course, Dana supported

student strategic engagement in authentic tasks (e.g., research, exam writing, and peer reviewing),

through class activities and assignments. In class, she shared her experience as a research collaborator,

emphasizing the importance of setting clear roles and expectations for each collaborator, as well as

understanding the shared task (i.e., what are we doing as a group?) and strategizing to make productive

decisions (e.g., what are each member's strengths to a particular group task?). She then offered her

students opportunities to practice strategic group work in different class activities (e.g., small group work

in two consecutive sessions and small group quiz). Dana observed that although some students did not

take up the opportunity to be strategic about in-class group work, they were more strategic (unprompted)

on their final group quiz.

Dana also fostered student strategic action in authentic tasks through assignments. In the SRL

assignments, she asked her students to reflect on their approach to answering challenging questions in

different situations (e.g., How do you go about planning your strategy for answering a question on an

exam vs. in an "inconsequential" situation?) and tied this to their second midterm ("… thinking about the

upcoming midterm, what do you expect to be the biggest challenge for you, and what is a strategy that

you will use to conquer this challenge?"). She also invited her students to think about themselves both as learners and researchers and reflect on their learning journey throughout the course in relation to those roles. She thought her students engaged in deep reflection about themselves as learners and mentioned: "… it was a good exercise for students as they may put this learning to good use in the future … it's not easy to support SRL, but even a little bit can help some of the students" (December CoI reflection template). In a different assignment, Dana offered her students the option to peer-review complete drafts of final projects to give them practice in a genuine activity in their field, but also as an opportunity to monitor the quality of their project prior to submission. At the end of the course and with the purpose of improving her teaching, Dana surveyed her students about how the three tools she had used to support them on their final project (i.e., marking rubric, marked sample assignments, and peer review activity) had helped them or not.

For future instances of teaching this course, Dana planned to have more specific SRL learning goals (e.g., monitor and document student progress in terms of their ability to use evidence to change their ineffective learning approaches) and redesign some course activities to allow students more agency in their learning (e.g., substitute midterms with collaborative and creative projects).

Mike

The context for Mike's SRL-focused teaching inquiry was an intermediate level multi-section course on math proofs, a course that is a gateway to more advanced mathematics. He oversaw two sections with sixty-five students in the second or third year of their studies enrolled in each section; I observed only in one of those sections. It was Mike's second time teaching the course and the class met three times a week (Monday, Wednesday, Friday) for 50 minutes each time.

Scaffolding Intuition in Math. Throughout the term Mike lectured using an SRL informed approach to delivering content to empower students to own their learning in his course. Figure 4.7 depicts Mike's journey of action and reflection about his SRL focused teaching practice.

Figure 4.7

Mike's SRL-Focused Teaching Journey: Cycles of Action and Reflection Across One Academic Term

Planning (June)
Goal: Develop intuitive approach for math reasoning
Strategies: Making explicit the process of proofing, scaffolding throughout course activities

Adjusting
Share student work samples
Give students 'no pen' time to interpret problems
Identified strategic action and motivation as SRL goals

Adjusting
Encourage shy students to participate
more and give students agency to do
their work strategically

Adjusting
Engage students in activities
outside of class time (peer review,
cumulative pass-fail homework)

Enacting
Explained every step
of a proof with a
rationale, generated
a positive
atmosphere in class,
invited student
contributions,
opportunities for
practice

Enacting
Fostered class
participation through
questioning and
discussion, scaffolding
through progressively
more difficult
problems. Did not
implement other
strategies.

Enacting
Implemented
student
contributions in
proofs, short
discussions in class
offered strategies
for proofing

Reflecting
*"Participation was good
... some students are
more critical, but others
don't take time to think
before writing."*

Reflecting
*"... they participate
quite well, and the
midterm average is
better than in other
sections..."*

Reflecting
*"They seem to be
participating and asking
questions more than usual
for this course..."*

September
**Modeling and
demonstrating**

October-November
Questioning and discussion

December
Guiding for independence

The First Cycle: Modeling and Demonstrating. Mike's goal was to teach his students to develop an intuitive approach to solving math proofs; that is, he wanted his students to develop a deep understanding of problem types and have an inherent awareness of how to solve and "proof" them. In June, he planned to make the process of proofing explicit in class and to request students to outline and explain their solutions in homework and exams. With this approach, he hoped students could develop their intuition for solving math proofs without costing him a lot of class time. As soon as the term started, he put this plan into action during lecture as he modeled and demonstrated in detail every step of a proof and offered students a rationale for following each step. Math proofs as a subject relies heavily on mathematical notation (e.g., written symbols and expressions) which Mike supplemented with long verbal rationales explaining each step for solving the proofs.

He used four moving blackboards (Figure 4.8) to annotate the proofs he was demonstrating step by step. In the first blackboard Mike introduced and wrote the proof. Then, as the class co-constructed the mathematical solution through dialogue, he wrote the sequence of notations on the other blackboards. At the end of each proof, the entire process to the solution (i.e., mathematical notations and rationale) was written on the blackboards. Mike's notes on the blackboard supported student task understanding and offered a visual prompt for his students to develop procedural and conditional knowledge about the process of math proofing. This approach also encouraged his students' active engagement throughout the lecture.

Figure 4.8

Mike's Moving Blackboards: Modeling Notation and Math Proofing
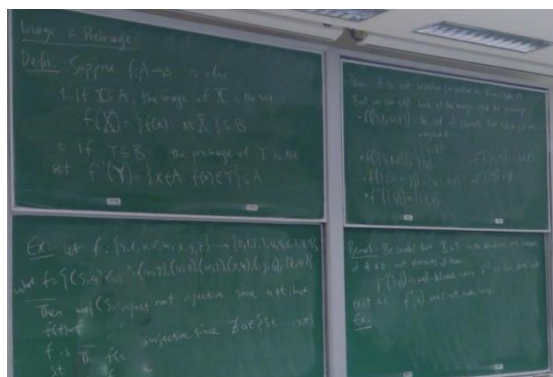
Since homework assignments (co-designed with the other instructors from other sections) focused on outcomes and not process and had already been designed for the term, Mike offered his students the opportunity of doing extra exercises out of class to practice the approach he had modeled and demonstrated in class. His students could choose whether or not to take advantage of this opportunity as it was offered in addition to homework assignments and had no grades attached. To foster student participation and engagement, Mike created a friendly, positive, and safe classroom atmosphere. For example, he greeted each student as they arrived and used their first names when they interacted in class. Throughout the lecture, students contributed their ideas on what to do first and how to continue (when solving the proofs) which Mike used as an opportunity to provide immediate formative feedback. When reflecting about his actions, Mike observed that student participation in class was good and some students "seem to be more critical about what is reasonable to write and what is not" (September CoI reflection template). However, he also noticed some students did not think before they dived in a proof. To strengthen his approach going forward, he expressed interest in sharing student work samples (i.e., written proofs) so their peers could see what worked and what did not work. He also thought about giving students 5-minute *no pen* midterm time so they could focus on interpreting the problems before writing the solutions. Mike identified strategic action and motivation for learning as the SRL dimensions he sought to enhance through his teaching.

The Second Cycle: Questioning and Discussion. Throughout October and November, Mike continued scaffolding deeper understanding and critical thinking by modeling/demonstrating a strategic approach to solving math proofs through progressively more difficult problems and offering his students opportunities for individual practice. He emphasized supporting student understanding of what they were being asked to do and how/why to approach it in one way or the other. To this end, he also demonstrated how different ways of interpreting a proof implied different ways for solving it. Further, he supported his students through questioning and discussion in and out of class (in office hours). For example, Mike purposefully posed more questions (e.g., How do we show that …? What does it mean to …?) and initiated discussions about student generated solutions to proofs (e.g., What can you say about …?) to

foster active learning, problem understanding, and more in-class participation. Through this approach, he sought to give students the framework to reason about math rather than simply be formulaic in their approach to it. Mike validated student contributions (e.g., different approaches to solutions and questions) and used errors/omissions as opportunities for learning when expanding on their suggestions. Mike shared different strategies for mathematical notation and monitoring of their solutions which fostered student procedural and conditional knowledge of strategies and encouraged flexible use of knowledge. During this period, Mike did not enact his plan to share student written work samples nor gave them 5-minute *no pen* time during the midterm.

When he reflected about his actions, Mike mentioned: "They participated quite well and the midterm average was better than in other sections [that he did not teach]" (November CoI reflection template), but he acknowledged that some of his students did not have the courage to participate. He wanted to continue listening to different voices all the time. He reminded himself about his goal for the semester: "to enable students to do their work in steps, getting to plan and work through the proofs accordingly" (November CoI reflection template). At this stage, Mike expressed interest in adding some reflection questions to homework to get students thinking about their understanding of the course and topics. However, he mentioned this would not be possible to implement during the term because the course team (i.e., instructors across sections) had already laid out course tasks for the term.

The Third Cycle: Guiding for Independence. In the final weeks of the course, Mike's focus was on strengthening student agency when solving proofs. To accomplish this goal, he continued promoting in-class participation, inviting his students to offer solutions that he then used to show and ask students whether that approach would work or not and why. These student contributions were similar to his initial idea of sharing student written samples; he facilitated whole-class short discussions on how variations of statements could be proven and continued offering extra practice problems. Mike included process-oriented feedback in homework solution sheets that mimicked the strategic approach he modeled in class. When reflecting about his actions, Mike mentioned: "They seemed to be participating and asking questions more than usual for this course, but students didn't seem to be doing the extra questions I gave

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them as practice" (December CoI reflection template). For future iterations of this course, Mike planned to engage students better in working outside of class time perhaps through cumulative pass-fail homework assignments where students keep writing the same questions until they can pass them. He also would like to implement a peer review platform where students can read each other's proofs and learn from them.

Vicky

Vicky's context for SRL-focused teaching inquiry was an introductory multi-section course on computer programming open to all first-year students in Applied Sciences programs. Most of the students enrolled in her section (92 in total) belonged to a college for international students within the university. Vicky had taught this course twice prior to participating in the study. Unlike the other courses described here, Vicky's course used a flipped model of instruction where the students watched videos introducing the topics prior to lecture time (twice a week for 90 minutes each time). Class sessions began with content review questions using clickers followed by students' work on worksheets with the support of the instructor and teaching assistants. Students also attended one lab session per week to design one or more stand-alone computer programs. These sessions were led by teaching assistants. The course had two parts: the first eight weeks focused on general computer programming, which Vicky oversaw, while the last five weeks focused on applied computer programming (where another instructor was in charge). Vicky remained available until the end of the term; she supported her students during office hours by offering feedback and encouragement to keep practicing learned skills.

Encouraging Reflection. Vicky informed her inquiry with observations from previous iterations of her course. She noticed that enrolled students often struggled to navigate the culture of working outside of class, as they tended to engage passively with the pre-lecture videos. She thought this passive approach to preparing for class hindered her students' meaningful engagement with learning during lecture time, as in previous offerings of the course students did not work through worksheets but rather waited for her to provide the answers. Figure 4.9 depicts Vicky's journey of action and reflection about her SRL focused teaching practice.

Figure 4.9

Vicky's SRL-Focused Teaching Journey: Cycles of Action and Reflection Across One Academic Term

Planning (June)
Goal: Encourage student pre-lecture preparation at a level that resulted in deep learning
Strategies: Making pre-lecture work active and problem-based

Adjusting
Shoulder-tap students who were struggling
Encourage in-class participation
Include SRL focused questions in class

Adjusting
Continue with short demos at the beginning of class

Adjusting
Integrate reflection in future courses

Enacting
Told students about the importance of preparing for lecture, reminded them about resources, and modeled an active approach to preparing for class, linked class preparation and performance.

Reflecting
"... the realization of importance of pre-lecture work had an impact at first but it is wearing off as students get busier."

Enacting
Short demos of how to interact with pre-lecture videos, introduced reflection questions at the start of class, fostered a growth mindset, offered students opportunities to practice active and strategic engagement with materials

Reflecting
"... [class time] feels chaotic but at the same time I look around and people are engaged in their learning ..."

Enacting
Pointed out resources, offered practice questions and let students pace demos

Reflecting
"Students were motivated in class, they wanted to finish the problems before I demonstrated the solutions..."

September
Encouraging pre-lecture preparation

September- October
Modeling and reflecting

October- December
Strategic exam preparation

The First Cycle: Encouraging Pre-Lecture Preparation. Vicky's main goal at the beginning of her inquiry was to engage her students in strategic pre-lecture preparation at a level that resulted in deep learning of the content covered in class. Her plan involved developing a programming practice tool that students were required to use to augment the pre-lecture videos and build a more solid conceptual understanding. Her expectation was that active engagement with pre-lecture materials would enable students to apply their knowledge in worksheet exercises and take more advantage of her support in class, participate in whole-class discussions, and improve their ability to demonstrate skills in lab tests.

In the first weeks of class, Vicky emphasized the importance of watching the pre-lecture videos and participating in class for a successful learning experience in the course. She also directed her students toward a list of tips (strategic approaches) of how to do well in the course. This list was available on the course web platform (e.g., "computer programming is something you learn by doing; if you make a mistake-read the error message, use it to identify the problem, and then correct it. If you are unsure whether something works, try it! If you get stuck, get help"). A few sessions into the term, she noticed that the students were not engaging productively with the pre-lecture videos, so she modeled an active way of interacting with them. In a brief conversation at the beginning of one class, Vicky asked her students to assess their progress and performance in lab tests and potential strategies to improve their outcomes. Vicky used this conversation as an opportunity to emphasize the importance of engaging strategically with pre-class and class materials to be successful in the course. After that session, Vicky observed: "The realization of importance of pre-lecture work had an impact at first but it is wearing off as students got busier … reflection on lab test performance changed some students' approach to preparation" (September CoI reflection template). Moving forward, Vicky wanted to reach out to students with low lab test scores to offer one-on-one support, encourage more student participation during in-class demonstrations, and include some SRL focused clicker questions at the beginning of class.

The Second Cycle: Modeling and Reflecting. Vicky could not get her programming tool ready for the term. Throughout October and November, she adjusted her plan to motivate students to come more prepared for class through modeling, demonstrating, and engaging students in reflection. She brought the

pre-lecture videos to class where she then talked about and showed her students how they could try to watch more actively. Vicky checked-in with the entire class at the beginning of sessions (through conversation and/or clicker questions); engaged students in reflection about their participation and interaction with course material in relation to performance on lab tests, the midterm, and worksheet completion; and had brief conversations about challenges students were experiencing and potential ways to overcome them (Figure 4.10). These activities offered her students opportunities to enhance their understanding of what was required of them as learners and in specific tasks.

Figure 4.10

Checking-In and Reflecting on Preparation and Performance in Vicky's Course

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Checking-in and reflecting on preparation and performance

In-class check-in (classroom observation 1):
"How did lab go yesterday and today? [Some students said it was terrible]
If [lab] *went badly, what do you think you could change to make it better?* [Students offered responses]
"You know what, this is really good learning, I bet some of you got things done but the more you practice and the more you do the things the better you will learn."

After the first midterm, Vicky invited students to reflect about their preparation for it and how it went for them. She asked the following clicker questions:

a.   *I found the material on the midterm… (easy, ok, hard)*
b.   *Given the length of the midterm, I need this much more time (0 min, 15min, 30 min, 60 min, more time)*
c.   *The way I prepared for the midterm was useful (Y or N)*
d.   *I will change how I prepare for the next midterm (Y or N)*
e.   *I want to change how I prepare for and participate in lecture (Y or N)*

After each question she summarized responses (e.g., *"that means a lot of you thought it was challenging"*) and sometimes followed up with more questions inviting students to offer their responses (e.g., *for those of you saying you wanted to change, what is a tangible change? What is something you'd do differently?"* She suggested some strategies to manage their time outside of class as well as resources to prepare for the second midterm (classroom observation 2)

Vicky's lecture required for her students to remain active during class time, so coming prepared was essential. For example, while she was reviewing a topic or solving a problem, she often invited students to contribute content and co-construct the solution (e.g., "… then what? You're skipping steps … What's next?", classroom observation 2). She modeled how she, as a computer scientist, solved problems and used different strategies to plan and monitor her solution. Vicky also invited students to think what

strategies would work best for them in different situations (e.g., preparing for lecture, studying for an exam, solving specific programming problems). While students were working on the worksheet exercises (at their own pace, individually or in small groups), Vicky and three teaching assistants walked around the lecture hall offering support and engaging with students in conversation about their approaches to solving problems.

Vicky would regularly debrief with the whole class to clarify common misunderstandings, showcase student generated solutions, review topics, and solve problems (she demonstrated solutions step by step). When reflecting about her teaching, Vicky said: "[Class time] feels chaotic … I look around and people are engaged in their learning … my goal was to motivate [students] to be more prepared to come into class and [engage in worksheets and discussions] … I feel they are" (classroom observation 2 debrief). In relation to asking students to reflect, Vicky said: "This approach is very different from anything I have done before … getting student reactions to the midterm before they received their marks back was good … I was encouraged by students wanting to change how they participate in lecture" (classroom observation 2 debrief). She thought she would continue motivating students through the short demos at the beginning of class.

The Third Cycle: Encouraging Productive Exam Preparation. The last two classes (end of October) that Vicky taught were just before the second midterm, so she used the time to encourage her students to be strategic about their exam preparation. Vicky pointed out resources (i.e., videos, online platform, exam samples, office hours), provided them with printed copies of practice questions, and let the students pace the demonstrations that she gave in class. Vicky noticed that "students were motivated in class, they wanted to finish the problems before I demonstrated the solutions and came to office hours with examples of their work and questions … I wonder if I was pushing/nagging too much" (November CoI reflection template). For future teaching opportunities she was going to think about how to integrate reflection for students into her classes.

Peter

Peter was the only instructor who was not actively teaching during data collection. He focused

his inquiry on a course he had recently taught and would either teach again or collaborate to redesign for future offerings. I documented his cycles as I did for the other instructors, but the classroom observations were replaced with a meeting where we talked in detail about a session of his choice that occurred during a term when he had taught the course. During these conversations, he explained how the session/activity had taken place and shared specific materials (i.e., slides, assignments, course outline) for that session. He then reflected on how he could tweak it to make it more SRL supportive. The context for Peter's SRL-focused teaching inquiry was an intermediate multi-section calculus course that was required for several majors including Computer Science. The students enrolled in this course (total 145) were in the second year of their program and many were transfer students who had not taken first year calculus at the university.

Analyzing a Course Through an SRL Lens. Peter's purpose for analyzing his course was to offer more agency over learning to students in future offerings of this course. Figure 4.11 displays Peter's inquiry journey of action and reflection about his SRL focused teaching analysis.

The First Cycle: Extending Reflections on Learning Achievement and Learning Habits. Once Peter familiarized himself with the SRL framework, he reviewed different activities he had implemented in his course and analyzed how these supported different components of SRL. In our first meeting (October), he identified a 2-stage diagnostic test and a goal setting activity he implemented on the first day of class as well as reflection questions given on a quiz. The 2-stage diagnostic test sought to gauge the students' calculus background knowledge to not only inform Peter's teaching but also to raise the students' awareness about their preparedness for the course. In the first stage, the students solved calculus problems individually while in the second stage, they collaborated in small groups to solve the same test. Immediately after each stage they answered questions about expectations for the course (Figure 4.12).

Figure 4.11

Peter's SRL-Focused Teaching Journey: Cycles of Action and Reflection Across One Academic Term

<u>Planning</u> (June)
Goal: Review course activities through an SRL lens
Strategies: Tweak activities to give more agency to students

Adjusting
Address study habits
Integrate reflection questions throughout term
Partner with students

Adjusting
Continue moving people past their anxiety about math, revise how to use diagnostic test to guide student preparation for course, design reflection questions to foster adaptive study habits, scaffold in-class activities

Enacting
Identified 3 activities implemented in the first few weeks of class that supported SRL. Brainstormed ideas on how to extend them beyond early weeks in the term

Enacting
Identified messages and course design features communicated on first day of class as supportive of SRL. Looked further into 2-stage diagnostic test as supportive of SRL

Reflecting
"...need more frequent reflection and return to goals to really get something out of it (for me and students)."

Reflecting
"... diagnostic test gave a clear signal to students who did not do well ... [I] learned about my students..."

June - September
Extending reflections on learning achievement and habits

October-December
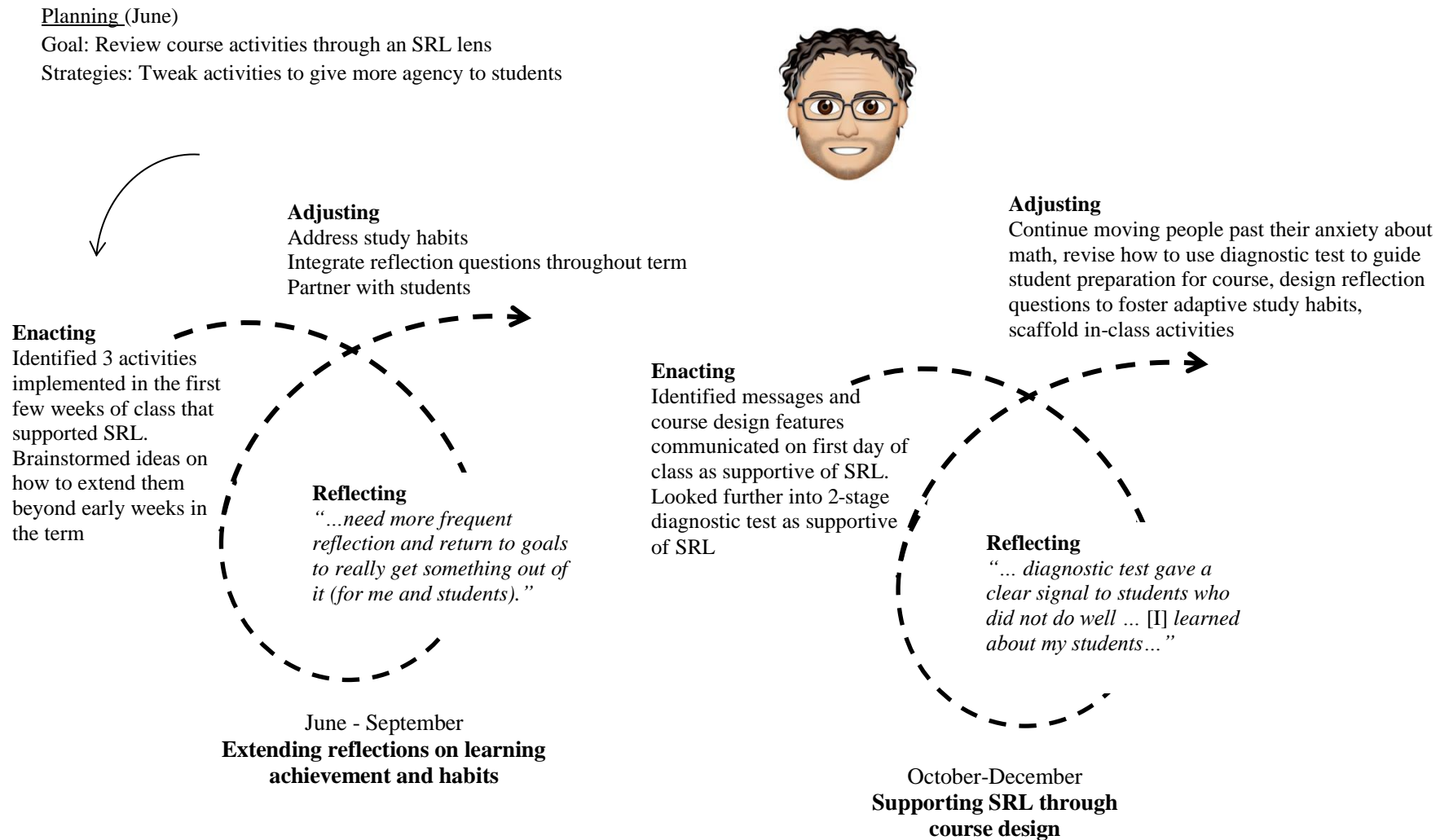**Supporting SRL through course design**

Figure 4.12

SRL Supportive Activities in Peter's Course

2-stage diagnostic test and goal-setting activity
- Stage 1-individual work: Please show your work, even if you're trying something you are not sure is correct. If you leave something blank or get stuck, write a little note about that (ran out of time, can't remember how do to this part, etc.). Solve problems individually.
  When you finish- *What do you hope to get from taking this course? What would success look like for you? Any question for me?*

- Stage 2- group work immediately after stage 1: Repeat in groups of 2 or 3- talk over your reasoning for each part. When you finish*, chat about what you hope to get out of the course; any questions from your group for me?*

Reflection on Quiz – week 3
1. *How did you prepare for Quiz 1?*
2. *Check which resources you used* (list of resources)
3. *Did you feel prepared for Quiz 1 when you saw it?*
4. *What has been the most confusing/challenging part of the course so far?*
5. *Any other comments?*

Peter identified the diagnostic test, along with the goal setting and reflection questions, as supportive of student metacognitive knowledge (i.e., thinking about themselves as learners in specific tasks and in the course) and as structures that helped foster a safe and positive classroom atmosphere. He was keen on exploring how to extend reflections on learning habits and performance further into the course to foster student metacognition and strategic action. At this point (observation 1), he brainstormed some potential strategies. Some strategies he came up with included: integrating reflection questions into all quizzes and inviting students to contrast their responses over time (e.g., "How have you changed your approach?"); revisiting student goals to monitor alignment of goals and achievement (e.g., Do you feel your goals are being met for the course? Have your goals changed?"); and engineering some multi-step tasks as sort of pre-post for problem solving. Peter also wanted to find out how students used available resources (e.g., textbook, web platform, videos, class notes, worksheet samples) to support their learning. In his future teaching, he wanted students to be strategic about their use of resources. To this end, he planned on revisiting a paper about the use of study resources in the context of an introductory course to statistics (Chen et al., 2017) and thought he could partner with students in this endeavor (i.e., asking

them: "What would you recommend to a student in your situation starting the course next year/term?; Do you feel you're benefiting from your discussions with peers?", observation 2).

The Second Cycle: Supporting SRL Through Course Design. When reviewing his class materials for our second meeting in November, Peter identified messages and course design features aligned with SRL that he communicated on the first day of class. For example, he communicated clear expectations for participation in and outside of class, and explained why he, who was not officially part of the math department, oversaw the course. Peter described how he invested some time during that session to ask students about their program/major and was surprised to learn that "there were more computer science and transfer students than [he] expected" (September CoI reflection template). He said this knowledge shaped his teaching over the term. He also explained how he created a positive, safe, and growth mindset environment in his class by emphasizing to students that his approach to math learning was related to social, effortful, deliberate, and adaptive practice (Figure 4.13).

Figure 4.13

Peter's Set Up of a Positive and Safe Environment

My approach (Slide 3, first class)
- Research is clear: Math is something that everyone can improve at, and your attitude about this, matters.
- You improve best through deliberate practice: not just solving a lot of problems but solving problems and using feedback to figure out which problems are challenging and need more work; taking some time to consider what is working and what is not.
- To support this, I will structure our time so that you will have practice both inside and outside class with opportunities for feedback from me, classmates, TAs, and sometimes computers. Make a calculus friend.

Moreover, he mentioned how he encouraged his students to show their work in the 2-stage diagnostic test, even if they were trying something they thought was incorrect, and suggested they write notes next to problems they found difficult. Peter noticed that the students were receptive to the 2-stage diagnostic test and their performance was high, especially in the group stage. However, in the individual stage some students failed, which allowed Peter to identify students who might struggle in the course. He mentioned that he followed up with these students individually to devise a plan of action (i.e., drop the

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course, continue with support). Peter thought the 2-stage diagnostic test supported SRL because it gave students the opportunity to become aware of their background knowledge for the course, work at their own pace, and co-construct knowledge with peers in a low-risk situation. He mentioned that if he were to use it again, he would make the test more challenging so students could engage in more enriching conversations in the group stage, in addition to giving him a more detailed picture about the calculus background knowledge of individual students. The latter would be useful to suggest tailored supports (e.g., specific resources, remedial courses) to students whose background knowledge was not sufficiently strong.

Peter mentioned that in future course offerings, he would also try making the course more meaningful for students by inviting them to think about the course in the context of their program (e.g., "Why does this course/topic matter in terms of my program?", observation 2). In relation to in-class worksheets, he mentioned that he would foster student engagement in monitoring and adjusting when working on problem solving. He said this focus would enable him and his students to know why/where students get stuck and generate strategies to overcome challenges. During this cycle, Peter realized that he had very little time to dedicate to the course and felt that, if he were going to teach the course again with an SRL lens, he would benefit from more time for planning and designing innovations for the classroom.

SRL-Focused Teaching Journeys: Integrating and Refining SRLSPs in Teaching

Each instructor had a unique journey of SRL-focused teaching which offered a nuanced picture of how SRL supports can or may be shaped in undergraduate courses. Despite differences in how the instructors chose to foster SRL in their courses, all instructors were successful in infusing or thinking about how to infuse their undergraduate courses with SRLSPs. Although the instructors occasionally experienced challenges to enact their plans, they were able to identify next steps for what they could not accomplish in this first term.

The instructors' journeys of action and reflection varied in the way they progressed through the processes of planning, enacting, reflecting, and adapting their SRL-focused teaching during the academic term. Mike and Vicky devised a plan for supporting their students' SRL and stayed close to it throughout

the term. They mobilized SRL principles into their teaching by refining their lecturing style and/or added SRL-oriented tasks to meet their goals of scaffolding intuition (Mike) and encouraging pre-lecture preparation through reflection (Vicky). Perceived time constraints and/or limited autonomy over the course design challenged Mike and Vicky to adjust their SRL-supportive plans. Nevertheless, they adapted the format of their original strategies on some occasions to overcome these challenges (e.g., Vicky demonstrated proactive lecture preparation instead of using a practice instrument tool). Mike and Vicky tended to use the new understandings built through situated inquiry to plan adaptations to goals and strategies for fostering SRL in future course offerings, which was similar to what Peter did as he reviewed his selected course through an SRL lens.

Driven by their shared goal of supporting their students' metacognition and/or strategic action, Laura and Dana integrated, tried, and adapted different SRLSPs throughout their courses in response to student uptake of the opportunities they were creating. This responsive approach resulted in a staggered journey that took Laura from lecturing about SRL to guiding student strategic problem solving and engaged Dana in refining her instructional goal of supporting SRL. In the face of challenges such as difficulty judging students' response to, or failure to take up, SRL supportive opportunities, Laura and Dana adjusted their strategies by tweaking or adding activities as the course unfolded (e.g., reflection question about midterm performance). Laura and Dana used new understandings emerging from each cycle of action and reflection to inform their immediate and future SRL teaching practice.

The instructors began their journeys committed to engaging in SRL-focused teaching inquiry and interested in enhancing their teaching and learning as informed by SRL. They brought different goals in relation to their practice, as well as diverse background knowledge and experience with learner-centred approaches to teaching and learning. These factors, along with features of their teaching context (e.g., course structure, autonomy over course design) may have influenced their journey to contextualize supports for SRL in their courses. The individual journeys of SRL-focused teaching are useful to understand the cross-case research findings presented in forthcoming chapters.

Chapter Five: Opportunities for SRL in Undergraduate Courses

In this chapter, I address the first research question: how did participating instructors infuse opportunities for SRL in their undergraduate courses? I present findings about the SRL supportive practices (SRLSPs) that the instructors implemented in their undergraduate courses and how, through these practices, they provided opportunities for their students to exercise metacognition, motivation for learning, and strategic action. Evidence for this question emerged from the instructors' reports of their actions in CoI reflection templates, my classroom observations, and course documents. Data analyses were theory driven and findings are organized in accordance with the Butler and colleagues (2017) interpretation of opportunities that develop and engage students in SRL, including: the creation of a supportive learning environment, activities, instructional supports, and assessment/feedback practices.

Creating Safe and Supportive Environments

I focused on three broad categories of actions instructors could take to create a safe and supportive environment: creating a positive and non-threatening space, fostering a community of learners, and establishing participation structures that enable active learning. Table 5.1 summarizes specific teaching practices, within these categories, particular instructors used.

Creating a Positive and Non-threatening Space

All the participating instructors sought to both motivate students for learning and foster a sense of belonging by establishing positive rapport with students and engaging in constructive and respectful interactions in and beyond the classroom. They set the tone for these interactions in the course syllabi as illustrated in a section of Dana's syllabus: "Keep an open mind. Have fun. 'Play' with the concepts and skills ... Challenge yourself. Be pleasant and courteous in class and online … with good will it's still possible to make the course a good experience." In addition, all the instructors strove to create and maintain both a welcoming classroom atmosphere and an approachable/supportive personal demeanor throughout the term. In the four courses where I observed, the instructors' interactions with their students were friendly and positive. For example, in one of Laura's lectures she empathetically laughed with her

Table 5.1.

Creating a Supportive Learning Environment

Broad Categories	Specific Practices	Used by Whom
Create a positive and non-threatening space for learning	- Establish positive rapport with students	L, D, V, M, P
	- Encourage students to reach out and seek support	L, D, V, M, P
	- Convey growth mindset messages	L, D, V, P
	- Listen and value student contributions	L, D, V, M, P
	- Communicate confidence in students as learners and knowledge makers	L, D, V, M
	- Offer opportunities for students to learn from mistakes	L, D, V, M
Foster a community of learners	- Promote co-construction of knowledge	L, D, V, M
	- Encourage and support peer to peer support and/or collaboration	L, D, V, M, P
	- Seek diverse contributions to knowledge making	L, D, V, M
Establish participation structures that enable active learning	- Establish predictable routines for participation	L, D, V, M, P
	- Share class presentations/notes with students	L, D, V, M
	- Discuss expectations and norms	L, D, V, M, P
	- Encourage students to generate strategies for achieving challenging tasks	L, D, V, M
	- Craft student-led lectures	D, V
	- Offer opportunities for practice in and beyond class	L, D, V, M, P
	- Encourage different ways of participation	L, D, V

L = Laura; D = Dana; M= Mike; V = Vicky; P = Peter (based on descriptions of his teaching practice)

class in response to a student's request to slow down and acknowledged she was going too fast at

introducing a new topic. Similarly, both Dana and Mike used their student's names when interacting with

them to create an amicable environment. Compared to courses with large class sizes, Dana's advanced

course with its small class size and Vicky's flipped classroom allowed for more personal interactions

between not only her and her students but also among the students themselves.

Each instructor I observed regularly checked-in with their students to see how they were doing

(either as a whole class or when they were working in small groups). In addition, all five instructors

actively encouraged their students to seek support and gave them feedback and suggestions intended to

enrich their learning experience. Peter described how he took time to learn about his students during the

first class (i.e., through a 2-stage diagnostic test and asking about their program/major) which helped him

shape his teaching over the term as well as guide some of his students to resources appropriate to their

individual backgrounds and needs. Dana added in her syllabus: "Your success in the course is as important to me as it is to you … I am committed to helping you find a way to be successful."

Laura, Vicky, and Dana additionally utilized the web platform and syllabi to define the course as a safe space where students were invited to learn and grow. For example, a section on Vicky's syllabus read:

> "The course is designed to be interesting, accessible and useful for all students—Computer Science majors and non-majors alike. No prior programming experience is assumed … the course will prepare you to learn more Computer Science skills and concepts in the future, either through formal courses or on your own."

Laura, Dana, and Peter emphasized growth and progress in learning in class through activities and feedback. In the first class, Peter described how he set a positive and growth-oriented environment linking math learning to social, effortful, deliberate, and adaptive practice. For her part, Laura designed a guided worksheet where she offered students to choose the most useful set of problems to work on, acknowledging that students might be at different stages in content and skill knowledge. Similarly, Dana engaged her students in drafting their final project in stages where she offered them timely and constructive feedback on each submission so they could not only advance their understanding but also enhance their final product.

A pattern I observed across the instructors was that they also listened to and valued student contributions. They validated their students' efforts at generating strategies/paths to solve problems. For example, after some students had shared their approaches to solving a problem with the whole class, Laura said: "There's lots of ways to do it. Any of those options would have worked. We saw three really great methods that would take us to using Newton's method" (classroom observation 1). Peter thought that inviting his students to share their expectations for the course (with him and peers) as well as their thoughts about how they were experiencing the course, was one way in which he valued and listened to student contributions. Each instructor I observed, communicated confidence in their students as learners and knowledge makers, and offered them opportunities to learn from their misunderstandings, errors, or

omissions either through in-class discussion or take-home activities. For example, after one whole class discussion Vicky suggested, "… let's try [the program] with the mistake, let's see the error there" and continued to explain what happened and why. Then, she involved students in finding a fix to the problem, ran the program once more and asked: "Who thinks this will do what we want it to do?" (classroom observation 2). By placing emphasis on errors being learning opportunities and linking effort and use of strategies to progress and learning, the instructors I observed, sought to empower their students to believe that improvement was within their reach.

Positive and constructive interactions between the instructors and their students also occurred outside of class in scheduled office hours, via email, and/or through online discussion forums. Vicky, Dana, and Mike offered individual/small group guidance and support beyond these traditional spaces by blocking off one hour immediately after class to attend to student questions about the lecture or assignments. Instructors reported these interactions informed them about students' understanding of tasks and content and revealed any struggles they were having in learning the subject matter. Further, the after-class sessions helped these instructors not only to support individuals' learning but also to plan their next steps in instruction for the group. For instance, when students presented with common misunderstandings, the instructors offered clarification to all students in subsequent lectures.

Fostering a Community of Learners

Across the courses featured in this study, data showed that the instructors and students partnered in knowledge building and engaged in peer-to-peer collaboration. Large class sizes and theater style spaces made it difficult to interact closely with small groups of students. Laura and Peter met this challenge by arranging online discussion forums to create a space where students could pose questions for their peers. Teaching assistants and instructors could monitor discussions and, on occasion, participate to answer questions. These forums were particularly active around homework submission or exam days. The instructors I observed turned traditional lectures (i.e., knowledge telling) into interactive and dialogic sessions where students participated in and built on one another's contributions. For example, in Vicky's class, students solved problems in small groups while she walked around offering support. She often

shared samples of student work with the whole class to prompt discussion and clarify concepts. Below is an excerpt from my first observation in Vicky's class:

> Vicky asked for the class' attention and said: "I stole someone's work and I don't want to keep it too long; it has a creative strategy …" She projected it with the document camera and went through the flowchart that the student made, pointed to a particular section, and asked: "What does this mean?" [One student replied]. Vicky validated the student's contribution and asked: "Does anybody have anything different?" Some students raised their hands and one of them said: "What if A is 0?" Vicky replied: "Ah! What would happen? What would we have to do?" Another student replied, and Vicky guided students to solve the problem. She summarized the problem, the creative solution and explained when, why, and how to use that strategy effectively.

With the exception of Mike, the other instructors invited their students to work in small groups during lectures or to complete assignments. Most collaboration between peers enrolled in introductory (Laura and Vicky) and intermediate (Peter) courses happened during class time through short-lived activities. As an illustration, Laura's guided worksheet activity encouraged students to work in small groups and rely on peers to solve problems and get 'unstuck'. Part of the instructions on this worksheet read: "Before you raise your hand for help, analyze what the problem is saying; plan an approach; think about how to verify your answer; think about content to review; ask your peers. I'll be circulating to answer questions", classroom observation 2). Similarly, the 2-stage diagnostic test that Peter described implementing on the first day of class was designed to enable students to enhance their understanding and learn with/from others through the group stage.

Dana, Laura, and Mike emphasized the relevance of building a community of learning beyond class time. For example, in her course overview, Laura included:

> "Other students in the course are an important resource. Ask the person sitting next to you if they want to work on homework together or meet at a coffee shop to study for the next exam. Talking to strangers is hard, but having a community is helpful and

important. If someone asks for help, keep in mind that teaching someone is a fantastic learning opportunity. Being able to do a problem on the homework is great, but often we learn even more when we're put in the position of explaining it to someone else."

In Dana's course, collaborative work was emphasized through group work in and outside of class in order for her students to learn and take advantage of their diverse backgrounds and expertise (e.g., engineering, biochemistry, biophysics) to analyze problems from different perspectives. Mike described how, during office hours, he guided and encouraged students to support one another in solving questions or clarifying misunderstandings.

Establishing Participation Structures That Enable Active Learning

In all courses, expectations, and norms for engagement in different activities were initially communicated through the web platform or syllabi in a somewhat standard way to fulfill program and/or university requirements. For instance, all instructors provided students with a course overview, calendar of activities, descriptions of course policies, how to get help, information about assignments, and evaluation criteria for each task. Clear expectations and instructions offered students an opportunity to build their understanding of what was required of them as learners in specific tasks and in each course.

Laura and Dana went beyond the typically contractual syllabus by creating opportunities for students to take control of their learning. For example, Laura's web-based course calendar was interactive and included more than just the sessions and content to be covered. She associated each session to assignments and resources (i.e., hotlinks to assignments instructions, expectations and grading criteria, lecture slides, and videos) that students could use to prepare for class and complete their assignments. Moreover, Laura made three formats of her lecture slides available (i.e., expanded, condensed printable, condensed digital) on the web platform. She intended for students to choose the option that best fit their learning needs: "The [expanded version] contains all the 'clicks' and it's useful if you want to review the process we went through in class; the [condensed versions] are useful to make meaningful annotations in writing or on the tablet" (Laura's course website). Other instructors I observed also shared class

presentations with students prior to lecture to foster active participation; they additionally and encouraged students to annotate class presentations with personally meaningful notes to help enhance their learning.

Dana's syllabus was extensive and offered her students a roadmap to activate metacognitive and strategic approaches to learning. For example, she included learning attitudes to develop in the course (e.g., "assess your own level of knowledge/skills, identify 'gaps' in your knowledge/skills, and take action to fill those gaps; think about your own learning"), a clear rationale for the course structure and activities, and how every aspect of her teaching sought to foster student development of 'expert-like' skills. She shared different approaches to preparing for class, working through assignments, and using resources. A section in her syllabus read:

> "The assigned readings may be completed any time during the unit. Some people prefer
>
> to read the material in advance, so that in class they can ask specific questions and focus
>
> on the parts that they found unclear. Others prefer to go to class, take good notes, and
>
> then do the readings. Both strategies are valuable."

Across the courses, all the instructors discussed their course and section specific expectations and norms during the first week of class. For example, Peter described how the last time he taught the course, he went through his syllabus and shared the underlying rationale and structure for his course and the activities in it with his students. He emphasized that there were specific requirements to pass the course and that learning was not necessarily tied to coming to lecture but rather to practicing inside and outside of class. Dana extended this practice by regularly dedicating class-time to go over the rationale and expectations for specific activities (e.g., assignments, in-class tasks) to prompt student metacognitive knowledge and skills.

In the courses I observed, the instructors set a specific routine for the week and/or classes. For example, in Dana's class, Friday was lecture day while Monday and Wednesday were anchored around discussion. Alternately, Laura interspersed brief lectures with individual/small group work throughout the week, while Mike had a weekly topic and led whole-group discussions each day that progressed from simple to complex problems. In Vicky's course, on the other hand, students first learned about a topic

through pre-lecture videos. At the beginning of each class, she used clicker questions to review content and then, students applied content and practiced skills as they completed worksheets in class while she offered support. Finally, they honed their knowledge and skill in the lab by applying and further practicing acquired programming skills and content. A predictable routine during class time sought to inform students about how to prepare for class and how to participate in it, thereby fostering motivation for learning, metacognition, and strategic action.

Finally, Vicky and Dana gave their students agency over their learning by providing opportunities for them to shape classroom routines and engage with course materials in a variety of ways. For example, Vicky's flipped teaching model enabled her students to control the lecture's focus, perhaps around specific questions they had about the pre-lecture videos or the application of concepts to in-class worksheets. Dana invited students to teach their peers and to give her feedback during the term about what was working for them and what was not. These activities encouraged her students to think about themselves and their peers as learners. Additionally, these activities informed Dana's teaching in real time which allowed her to enhance different aspects of the course long term. All the instructors sought to stretch student learning by offering their students multiple opportunities for practice (e.g., homework, extra exercises), sometimes for credit and sometimes not. Peter described that on the first day of class when he shared his approach to teaching with his students, he said: "To support [deliberate practice], I will structure our time so that you will have practice both inside and outside class with opportunities for feedback from me, classmates, [teaching assistants], and sometimes computers" (observation 2, PowerPoint slide).

Activities

In this section, I focus on specific activities some instructors designed and/or implemented with the explicit intention of promoting student engagement in SRL in their courses, including planning and reflection activities (Vicky, Laura, and Dana), Laura's problem-solving worksheet, and Dana's process-oriented tasks. In our conversations, Peter identified and described two activities (i.e., 2-stage diagnostic test and quiz reflection) he used in his course that he thought could foster his students' SRL, so I also

included them in this section. Mike did not design specific SRL-focused activities. When I collected and analyzed data, I looked at whether and how the activities the instructors designed to foster student agency in learning addressed multiple instructional goals, extended over time, engaged students in strategic and metacognitive thinking, and were authentic (per Perry, 2013). Importantly, in the four courses I observed, the instructors guided students' SRL through mini-lessons, which reflect an activity structure, but I focus on this student-centred lecturing style in the next section, where I describe the instructors' instructional supports and co-regulation.

Instructional Goals

The activities that Vicky, Laura, Dana, and Peter used in their courses integrated to varying degrees, multiple instructional goals that built on one another and sought to develop meaningful and useful skills. Instructional goals included learning content; developing field specific processes (e.g., accurate communication through mathematical notation); and/or using and developing higher-order (e.g., goal setting, monitoring) and other learning skills (e.g., working in groups, giving/receiving feedback, preparing for exams).

Both Laura and Dana developed and integrated activities that emphasized content, field-specific skills, and learning goals. Laura designed a problem-solving worksheet that consisted of a collection of problems intended to engage students in choosing their focus for the lesson (i.e., reviewing content, practicing strategic problem solving, or applying mastered concepts to unfamiliar situations). While it primarily emphasized content learning and practice of field specific processes (i.e., identifying relevant information in a calculus problem, comparing solutions when calculated by hand and computer), the activity also sought to develop higher-order learning skills (e.g., planning, monitoring). Similarly, Dana's activities targeted multiple instructional goals too, but she added one layer of support to foster her students' understanding of the tasks, their relevance, and underlying instructional goals. She offered an explicit rationale for each activity, defined clear goals she intended for her students to attain, and explained how they could benefit from working towards those learning goals. For example, Dana explained that the portfolio was a way for her "to recognize and give credit for all the hard work that

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[students] complete[d] in terms of homework, readings, and preparation for class, and also for [the students'] personal learning that may not be reflected in the exam or project performance" (syllabus). She also let students know she was going to use the portfolio to gauge student engagement, effort, and interest in course activities to both inform her teaching and as a source of information to write letters of reference. Finally, Peter's description of the 2-stage diagnostic test demonstrates how he thought this activity could integrate multiple instructional goals (i.e., checking calculus background knowledge and use of strategies, tracking and sharing problem-solving reasoning, and working individually and collaboratively) to support SRL.

Reflection activities that were implemented once focused mostly on developing higher-order learning skills. For example, in Vicky's course, prior to receiving the midterm grades, she asked students to respond to clicker questions that invited them to think about how they had prepared for the midterm and whether the strategies they used had been effective to meet the midterm demands. Then, Vicky led a whole group debrief discussion where she had her students share strategies and ways in which they could change (or not) the way they approached their preparation for the midterm. Similarly, Laura invited students to look back at their midterm to characterize their errors according to predetermined categories (i.e., algebraic error, difficulty interpreting the question, limited concept understanding, attention error) as a way of fostering her students' growth mindset and awareness of themselves as learners in a calculus test situation. Peter thought that the reflection questions he included in a quiz (e.g., How did you prepare for Quiz 1? Did you feel prepared for it when you saw it? What has been the most confusing/challenging part of the course so far?) could foster student metacognitive knowledge and skills.

Extension Over Time

Some activities (i.e., Laura's reflection and worksheet, Vicky's and Peter's reflection) were short-lived in the sense that they completed during a single lecture period or implemented only once in the semester. Nevertheless, the instructors' intention was to engage their students in planning and sequencing their thinking (about specific topics/skills) and learning processes as well as overcoming challenges to accomplish meaningful goals. The expectation was for students to use these in-class activities as a

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springboard to engage deeply with content and skills outside of class (i.e., in homework assignments or non-credit exercises (extra practice).

In Dana's course, process-oriented, planning and reflection activities were integrated throughout the course to engage her students in deep learning of specific themes (units of study) and skills over time. For example, she designed a collaborative activity in which students first selected a topic of interest then formed small groups according to their shared interest. Throughout the week, the group explored and discussed each topic in depth following a specific analysis structure while Dana guided them through understanding and engaging in effective collaborative work (i.e., shared-regulated learning). Dana implemented this activity for three consecutive weeks to give her students many opportunities to practice how to collaborate productively (each week the topics and groups changed) and at the end, students took a collaborative quiz.

Engagement in Strategic and Metacognitive Thinking

By using specific SRL-supportive activities, Laura, Dana, and Vicky sought to engage their students in various components of the cycle of strategic action (i.e., task interpretation, goal setting, planning, adaptive and flexible use of strategies, and monitoring). For example, through their reflection activities, Laura and Vicky intended to engage their students in self-evaluation based on external or internal feedback with the hope that students would adjust their approaches to studying in future exam situations. Dana's formative reflection activities sought to engage her students in monitoring their learning processes based on internal feedback. In this way, students could adjust their understanding of tasks, goals, and strategies as necessary to engage in productive learning in subsequent opportunities offered in the course. As Peter analyzed his course through an SRL lens, he observed that the two questions (i.e., What do you hope to get from taking this course? What would success look like for you?) he included at the end of the 2-stage diagnostic test had potential to engage students in goal-setting processes.

Laura and Dana engaged students in complete cycles of strategic action through specific SRL-supportive activities. Throughout the term, Laura aspired to foster strategic thinking and problem solving

by encouraging students to understand and interpret problems prior to engaging in computations or using strategies. She modeled this strategic approach in class and asked students to stop, think and plan how to solve the problems using various strategies/paths, and encouraged them to verify their solutions. Towards the end of the term, Laura implemented the guided problem-solving worksheet. She expected her students to interpret the task, which demanded them to think metacognitively (i.e., choose which section to work on based on where they were at in their learning, the skills they needed to enhance), and to approach the task and each problem strategically (i.e., working in groups, identifying resources, solving the set of problems, monitoring their performance, and recruiting strategies to address challenges). In her instructions she emphasized: "The point is planning an approach, not the solutions. In particular, how to verify your answers, verify if your problem makes sense and how many ways can you figure out to solve it" (classroom observation 2). Through a simple task, Laura brought to life the cycle of strategic action for thinking and problem solving she had modeled throughout the term, fostering student independent practice.

Dana designed and implemented activities (e.g., process-oriented tasks) that engaged her students in full cycles of strategic action with emphasis on task understanding, planning, enacting strategies, and monitoring progress in authentic activities. For example, in the small group in-class discussions referred to above, Dana wanted her students to practice strategic collaborative learning by spending a few minutes prior to the task: "a) checking if they all had the same understanding of the task at hand; and especially, b) planning how they were going to work together on the task" (classroom observation 2). At the end of group work, Dana followed up with her students to assess whether and how following the steps in the analytic structure she provided was useful to advance their learning about the topic they were exploring. This prompt encouraged/required the students to consider whether and how to adapt or strengthen strategic collaborative approaches to learning during the next iteration of small group work.

Authenticity

The specific SRL supportive activities that Vicky, Dana, Laura, and Peter used in their courses were authentic in the sense that they were necessary building blocks towards obtaining a university

degree and developing meaningful learning skills. For example, the one-off reflection activities (Vicky's, Laura's, and Peter's) encouraged students to engage in strategic learning processes (e.g., monitoring and adjusting) to take control of their learning, but it was ultimately up to their students to make that connection. Dana and Laura made connections between the process-oriented tasks they used and content/program apparent to their students. For example, when setting up small group work in her class, Dana said: "Work with someone you haven't worked with before, so that you [learn how to work with people you do not know] and have contacts when you go on to work in industry or grad school" (classroom observation 2). Similarly, when Laura introduced her problem-solving worksheet, she made it more authentic by saying:

> "You have a whole lot of problems and when you're studying for an exam you also
> have lots of problems and you don't really need to do all of them. Instead, you choose
> the problems that are useful to you … It is nice to have solutions but in exams you don't
> have them, so it is really good practice to think how you can verify your solutions"
> (classroom observation 2).

Instructors like Vicky, Dana, and Laura guided their students to focus on big ideas rather than on the mechanics through authentic supports like providing useful formulas for problem solving or having open text exams or collaborative quizzes. Their argument behind this practice was that in real life people do not memorize formulas and they use resources at hand (e.g., literature, peers) to solve problems.

The specific SRL supportive activities that Laura, Dana, and Vicky used and Peter identified, intended to be meaningful for learners in the sense that they integrated content and skills, offered students opportunities to experience challenges, or promoted understanding of what it means to think and act like a mathematician, biologist, computer scientist, and/or a researcher "in the real world." Dana and Laura integrated these characteristics to a greater extent throughout the specific SRL supportive activities they used. Dana took advantage of the applied nature of her course to design and implement activities that engaged her students in rich forms of thinking and learning they could find immediately meaningful. For example, the final project and in-class discussions encouraged the flexible use of knowledge and skills as

the students thought about current topics in the field and were exposed to processes that biologists or researchers experience (e.g., researching, reporting, and collaborating). In their courses, Laura and Vicky relied on homework assignments that required their students to apply concepts to situations with real life meaning (e.g., in Vicky's course students applied knowledge and skills to designing stand-alone computer programs), but they did not embed SRL supports into these assignments.

Instructional Supports and Co-Regulation

With regard to instructional supports and co-regulation, I was interested in whether and how the instructors operationalized four possible instructional supports: engaging students in choice and decision making, offering opportunities for students to control challenge, involving students in individual and/or social forms of learning, and scaffolding practices. Table 5.2 links these broad categories of support to particular practices at least one instructor used. In this section, I describe supports the instructors provided in class (based on observations and CoI documents) and out of class (e.g., based on instructors' descriptions of interactions with students in office hours or in the discussion board).

Table 5.2

Instructional Support/Co-Regulation Practices

Broad Categories	Specific Practices	Used by Whom
Engage student in choice and decision making	Offer opportunities to:	
	- Decide how to apply knowledge and skills	L, D, V
	- Ponder task demands and needs as learners to guide work	L, D
	- Pursue further exploration/learning of specific topic	D, V
	- Select resources and approaches to learning	L, D, V
	- Decide how to represent their learning	D
Opportunities to control challenge	- Invite students to complete work at their own pace	V, D, P
	- Design activities with multiple entry points	L, D
	- Invite students to explore topics of choice	D, V
	- Invite students to think about performance criteria	D
Engage students in individual and social forms of learning	- Co-construct knowledge in small groups/whole class discussions	L, D, V, M
	- Offer opportunities for independent work followed by group work	L, D, V, P
	- Encourage peer to peer support and or collaboration	L, D, V, M, P
Guide students towards independent learning	- Model, demonstrate	L, D, V, M
	- Ask metacognitive questions	L, D, V, M
	- Through tools	L, D, V, M

L = Laura; D = Dana; M= Mike; V = Vicky; P = Peter (based on descriptions of his teaching practice)

Engaging Students in Choice and Decision Making

Laura, Dana, and Vicky supported students' autonomy by offering them opportunities to make meaningful decisions and take responsibility for their learning through in-class activities. For example, these instructors encouraged students to make decisions about how to apply the knowledge and skills they were learning when practicing problem solving or completing worksheets (e.g., what methods/strategies to use, how to keep track of their work, whether to work independently, in pairs or small groups, what resources to use). In her worksheet activity, Laura involved her students in decision making that required them to ponder task demands, how they wanted to approach it (e.g., individual/group) and reflect on their learning strengths and challenges (e.g., What problems do I need to work on?). In the debrief about the problem-solving worksheet, Laura said: "Students were invited to 'really choose' the problems that were best for them to advance their learning" (classroom observation 2). Across the term, Dana invited her students to explore topics of their choice to meet different purposes like teaching a technique to their peers, working in groups to delve deeper into a shared area of interest, or pursuing individual research. She saw these as opportunities to motivate her students to advance their learning and skills in specific areas within the field of study that could be useful in the workplace or future graduate work. Vicky's students had opportunities to further explore areas of interest in the lab component of her course where they could apply content and skills to programming projects.

In relation to engaging students in meaningful decision making outside of class, the instructors teaching introductory (i.e., Laura and Vicky) and intermediate courses (Mike and Peter) did not create opportunities for meaningful decision making about what to learn or how to approach learning (e.g., individually/group, format, submission) through homework assignments. Dana, however, did. For example, in the final project assignment (i.e., a mini research proposal), she gave her students multiple opportunities to make meaningful choices: students could decide whether they wanted to work individually or as a team, and they could choose the topic they wanted to explore as well as how to approach it (i.e., design the experiment, select techniques). Moreover, her students could choose to submit cumulative drafts of the project over time to receive [in]formative feedback from Dana and/or peers, or

just submit the two parts that were graded (i.e., research question and project outline). In the portfolio assignment, the students could decide how to represent themselves and their work to share with peers and Dana. For instance, they could design their home page (i.e., to showcase who they were, their interests in developmental genetics) and which pieces to include from the list of assignments they had completed during the course to represent their learning growth in the course.

Opportunities to Control Challenge

This form of instructional support was not as common in introductory (Laura and Vicky) and intermediate courses (Peter and Mike) in the sense that learning goals, expectations, level of difficulty, and requirements were often the same for all students. Nevertheless, the instructional format of Vicky's course and Laura's problem-solving worksheet had built-in supports for students to take control over challenge. The flipped model of instruction used in Vicky's course enabled her students to navigate through content and skills to fit their strengths and challenges. They could engage differently with pre-lecture videos and they completed worksheets at their own pace, individually or in pairs/small groups during class. Still, like in other introductory and intermediate courses there was no accommodation or negotiation over expectations or level of difficulty for the tasks, and the students had to complete the worksheet because they had to submit one problem per session (selected at the end of class). Laura's guided worksheet with multiple entry points (i.e., sets of problems that required different levels of knowledge and skills) for her students to select where they wanted/needed to focus their practice is a good example of an activity that offered opportunities to control the level of challenge. I did not have evidence from Mike's and Peter's teaching related to opportunities for students to control challenge.

Dana embedded more opportunities for her students to control the level of challenge. For example, she offered students the opportunity to teach their peers about a specific experimental technique that they were interested in learning about or had mastered, and then lead a whole-class discussion. In this activity, the level of challenge was individualized, and the students added their own learning goals to those that Dana had identified. For the final assignment, Dana was willing to make accommodations for those students who wanted to work as a team, invited them to think about performance criteria, and

encouraged them to present their work at an undergraduate conference. These activities shifted the responsibility for their learning and performance to the students.

Engaging Students in Individual and Social Forms of Learning

Evidence showed that each instructor encouraged their students to transition from individual to social forms of learning. For example, in the four courses I observed, co-construction of knowledge permeated through direct and guided instruction in lecture time where students were constantly invited to contribute to knowledge making in whole class discussions. Similarly, Vicky, Laura, and Peter engaged their students in activities where they first worked on their own and then in groups (e.g., 2-stage diagnostic test, clicker questions, think-pair-share). When Vicky used clickers to review content, the students answered individually, and these responses were used as a springboard for small group and/or whole-group discussions. In each course, the instructors strove to support their students to understand how to approach tasks and material individually to empower them to take control over their performance in individual assessments.

To greater or lesser extents, all instructors across courses encouraged peer to peer support and collaboration in and/or beyond class. For instance, a common feature of all courses was having web-based discussion forums where students could offer and seek peer support. For example, a section on Laura's web platform read: "Often we learn even more when we're put in the position of explaining it to someone else. Helping out your community members is an important habit to develop." These discussion forums were very active in Peter's and Laura's courses where peer-to-peer support in class was more limited due to the class size. Likewise, Mike encouraged his students to guide one another's understanding when they came in groups to office hours. Students in Vicky's, Laura's, and Dana's courses had opportunities to think through or work in pairs or small groups before whole class discussions. But Vicky's flipped-instruction model and Dana's small class size enabled them to dedicate more class-time to small group activities than Laura could. In addition to having the opportunity to collaborate when solving worksheets, Vicky's students could submit the same assignment acknowledging they had collaborated through it. One

of Dana's learning goals for the course was to support students to learn how to collaborate. To this end, she introduced the importance of collaboration on her syllabus:

"Scientists (at least biologists) never work in isolation—they collaborate. So work with your classmates! It is only by bouncing ideas around and explaining concepts to each other that people truly learn and improve. Please keep in mind that there are multiple aspects of working together, and communication is key. Some people prefer to think through ideas and concepts individually first: if this is you, please don't feel obligated to jump into discussions right away but let your group members/classmates know that you'd like to first think things [through] quietly. On the other hand, if you are one of the people who prefers to start by brainstorming with others, go right ahead, but please be considerate of those who wish to work independently first, and make sure when they are ready, they are invited to share their ideas."

Dana brought these ideas to life in her course by offering her students multiple opportunities to practice collaborative work and support one another. She engaged students in small group work in class and through assignments, invited students to review others' final projects to offer constructive feedback, and implemented a collaborative quiz.

Guiding Students Towards Independent Learning

In the four courses I observed, the instructors guided their students towards independent learning by modeling, demonstrating, and asking metacognitive questions to engage students in strategic approaches to problem solving within their respective disciplines. This guidance offered students opportunities to enhance their understanding of valued skills in their contexts of study.

Each instructor I observed used modeling and demonstrating as strategies to introduce new topics in mini-lessons on concepts and skills, which sought to foster students' metacognitive knowledge and skills and strategic engagement with learning activities. They also modeled the framework to strategic problem solving to give their students a 'template' to follow when working in activities or outside of class. In particular, these instructors were explicit about how they were thinking through problems or

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topics, what strategies worked for them when using specific content or applying knowledge and skills, how to monitor their progress, and troubleshoot if necessary. They supplemented in-class modeling with whole-class guided practice in which they supported their students to work through progressively more complex problems or specific topics to then build the solution based on student contributions and instructor/peer feedback.

In each course I observed, the instructors used strategic questioning to shape guided instruction in class. They asked questions like: "What is the problem asking you to do?" (Laura, classroom observation 2), "How do you think you can approach this proof?" (Mike, classroom observation 2), "What is surprising about that result? Why?" (Vicky, classroom observation 1). Other questions engaged students in reflection about their learning. For example, in a group activity in which Dana sought to engage her students in productive collaborative learning, she checked-in with them: "How is it going? Was the way you decided to work useful to meet your goals? What were the most challenging aspects of the process?" (classroom observation, 2). As the term progressed and the students got used to these instructional supports, the instructors faded in-class scaffolds by chunking in larger pieces the different steps to a solution or to thinking through a topic. Each instructor I observed, encouraged student independent work from the beginning of the term as students were required to apply knowledge and skills outside of class in activities that were designed to support this transition (e.g., homework assignments).

A pattern I observed across all four instructors is that they used tools to facilitate student engagement in thinking and learning processes, particularly strategic action. For example, Dana's instructions for the final project included a suggested timeline for completing it in stages supplemented with a performance criteria rubric. Before and after each lecture, Vicky posted a 'to-do' list on the web platform with highlights and effective ways to review the lecture in order to apply that knowledge and skills to the pre-lab homework. Mike used moving blackboards to co-construct the solution process to proofs with the intention of fostering student task understanding and strategic approaches to math proofing. Laura shared different versions of her class notes for students to focus on different aspects of strategic problem solving.

Assessment and Feedback Practices

Regarding assessment and feedback practices, I looked at whether and how the instructors engaged their students in dialogue about learning processes, offered formative feedback, and provided opportunities for self-assessment. Table 5.3 summarizes practices associated with these categories and indicates who used them.

Table 5.3

Assessment and Feedback Practices

Broad Categories	Specific Practices	Used by Whom
Engage students in dialogue about learning processes	- Share field-specific learning process	L, D, V, M, P
	- Mention helpful learning resources and how/why they are helpful	L, D, V, M, P
	- Have explicit conversations about strategic learning	D
	- Check-in with students about their learning process	V, D
	- Offer opportunities to think about learning and performance	L, V, D
	- Offer opportunities to refine approaches to learning	D
Offer formative feedback	- Give timely, descriptive, and task focused feedback in class	L, D, V, M, P
	- Use student contributions to guide learning	L, D, V, M
	- Engage students in peer-to-peer feedback	L, D, P
	- Guide teaching assistants to give process-oriented feedback on assignments	M
	- Give [in] formative feedback in assignments	D
Opportunities for self-assessment	- Engage students in reflection about performance	L, D, V
	- Lead whole-group discussions about strategies that work/didn't work	V, D
	- Engage students in iterative formative/retrospective reflection assignments	D
	- Ask students to reflect how tools/resources support their learning	D

L = Laura; D = Dana; M= Mike; V = Vicky; P = Peter (based on descriptions of his teaching practice)

Engagement in Dialogue About Learning Processes

With the purpose of fostering strategic engagement in learning activities, during the first week of classes, all instructors made a point of talking about learning processes and pointing their students in the direction of specific resources that would help with learning. For example, Peter described that on the first day of class, he shared with his students that they needed to "[solve] problems and [use] feedback to figure out which problems [were] challenging and needed more work, and [take] some time to consider what [was] working and what [was] not" to improve in math (observation 2, PowerPoint slide). All

instructors drew attention to the syllabus or web platform where they were more explicit about specific learning resources and/or strategies on how to learn in their disciplines.

However, it was only in Dana's class where explicit discussions about learning processes took place throughout the term. For example, she used class time to talk about the cycle of strategic action as an effective 'tool' to approach learning in general and mentioned how she approached her work following the 'steps' of the cycle. Then, she led a whole class discussion about it.

Dana, Vicky, and Laura used strategic questioning to support their students to focus their attention on thinking and learning processes while engaged in tasks. For example, Vicky began class with an informal check-in for students to share about their learning experience (e.g., "How was lab yesterday?", classroom observation 1), which allowed students to exchange ideas on how things were going (e.g., effective/ineffective strategies) and how to continue with the purpose of enhancing their learning. These conversations were also useful to inform the instructors' teaching. In addition, they asked students how their engagement with in-class activities was going (e.g., when students worked in small groups), which allowed their students to make their learning process explicit in whole-group discussions. In these short discussions, students shared how they had approached specific tasks as well as the challenges they faced and how they had overcome them. Through specific activities, these instructors also offered their students opportunities to think about their learning and performance (e.g., reflection assignments). Further, Dana offered her students opportunities to devise strategies to refine their approaches and continue making progress (e.g., SRL assignments and the final project survey). I did not observe, nor did Mike report any instances where he engaged students in dialogue about learning processes.

Formative Feedback

Across courses, both instructors and peers played an important role in giving feedback to inform student learning and instruction. All instructors provided just-in-time, descriptive, and task focused feedback during lecture time, sometimes to the whole class but also in the context of small group work. For example, as Laura was checking-in with small groups during a short in-class activity, she asked

everyone to pay attention: "I've gotten the same question twice. General rule of thumb is if you're getting numbers that are similar to each other it means you're getting close to the root" (classroom observation 1). All instructors used student contributions in class to offer feedback in whole-class discussions. For example, in Mike's class, when a student offered an alternative path to a proof, Mike solved the proof using his and the student's approach and then debriefed the pros and cons of each approach with the class.

Peers shaped learning and instruction through discussion forums in the web platform, particularly in Laura's and Peters' courses, and within constructive dialogue across courses. Some instructors engaged students in more formal instances of peer-to-peer feedback. For example, Peter described that in the 2-stage diagnostic test, peers gave feedback to one another while discussing their individual work and then came up with a shared solution for the test. Dana, on the other hand, invited students to peer-review complete drafts of the final project and offer one another feedback based on the project's rubric and their own experience.

Course structure and level seemed to influence the instructors' control over assessment and feedback practices. Assignments in introductory (Laura and Vicky) and intermediate (Mike and Peter) courses were designed at the course level and graded for completeness and accuracy by teaching assistants. Solutions to assignments and midterms were often posted on web platforms and students only received a grade and not specific feedback. To overcome this barrier, Mike guided his teaching assistants to give process-oriented feedback on assignments and gave his students solution sheets which walked them through the problems as he did in class. Due to the size and level of her course, Dana created all assessment and feedback practices to guide student learning. She offered her students formative verbal and written feedback so they could revise their approaches to learning and control their progress.

Self-Assessment

SRL supportive opportunities for students to engage in self-assessment varied according to course level. Except for Mike, the instructors in other introductory and intermediate courses designed reflection activities that they used once across the term (e.g., Laura's and Vicky's midterm reflections, and Peter's description of reflection questions in a quiz). These activities sought to raise student awareness of their

study habits or typical errors so they could understand themselves as learners in relation to particular tasks and adapt their approaches to studying and learning. For example, in Laura's midterm reflection she asked her students to list their errors/omissions, classify them according to typical causes for making mistakes in calculus, and generate an approach to not repeat them in future exam situations. Vicky and Peter also used student reflections to inform their teaching and to debrief with the entire class about common challenges and strategies to overcome them. Vicky implemented a reflection activity after the midterm to encourage students to approach lecture preparation more productively. Peter identified the reflection questions he included in a quiz the last time he taught the course, as opportunities for students to focus on deep learning and understand how they were doing and what else they needed to do to meet learning objectives (i.e., "Did you feel prepared for the quiz? What has been the most challenging part of the course so far?", observation 1).

On the other hand, Dana created several opportunities to engage her students in iterative self-assessment throughout the term to foster student metacognitive knowledge about tasks, learning, and themselves as learners. She combined formative reflection and retrospective reflection to enable her students to think about processes they had engaged in and ways in which they could approach future assignments given their learning experience. Dana provided her students with assessment criteria rubrics which she discussed with students to guide their task understanding and progress, as well as to generate feedback for peers (e.g., "Think about evaluation criteria for your draft research question assignment. What makes a top-level draft research question assignment?", R&R1 assignment).

Dana's reflection assignments were task focused but also encouraged her students to think about themselves as learners in the broader context of the course and of their programs. For example, in her last reflection assignment, she had her students think about their learning journey through the semester by asking:

"What is one thing that you learned and that stands out to you? Why does it stand out?

Think about a skill or concept that you were not very confident about at the start of

term. Has your confidence changed throughout the term? Why do you think it has or has

not changed?" (Dana's R&R5 assignment).

At the end of the term, Dana asked her students to think how the three tools used to support their

engagement and process in the final project (i.e., the marking rubric, marked sample assignments; and the

peer review activity) had helped them. This survey served both as a tool to inform their learning as well as

to inform her teaching.

SRL in Undergraduate Courses: Summary

In this chapter, I documented how five university instructors infused or identified (in the case of

Peter) supports for SRL in their undergraduate courses as they participated in SRL-informed inquiry. In

general, the instructors in my study were thoughtful about how they could bring SRLSPs to their courses

in a meaningful/context-sensitive way to transform traditional undergraduate lecture courses into active

learning spaces. While there were similarities across cases/courses, nuances did surface in relation to how

the instructors designed, implemented, and/or embedded SRLSPs in their courses. Each of them

accomplished it through different practices, demonstrating different paths to common outcomes.

All the instructors implemented different SRLSPs with the purpose of creating a safe and

supportive environment for students to bolster students' sense of belonging and confidence as learners.

By using the syllabus and/or having discussions in class, the instructors established a positive and growth

focused classroom climate. They established participation routines and structures with clear roles and

responsibilities through which their students could efficiently focus on their learning and contribute to the

co-construction of knowledge. In addition, the instructors fostered a community of learners inside and

outside the classroom (e.g., during office hours, through discussion forums), but Dana's small class size

Vicki's use of the flipped instructional model seemed ideal for facilitating interactions and relations in the

classroom.

In relation to activities, Laura, Vicky, and Dana designed specific SRL supportive tasks and Peter

identified activities he uses in his course (when teaching) to support SRL. Some of these activities

integrated multiple instructional goals (e.g., Laura's problem-solving worksheet and Dana's final project)

while others focused on fostering meaningful learning skills like goal setting and/or monitoring (e.g., Vicky's midterm reflection). Activities varied in the sense that some SRL supportive activities were implemented only once in the term (e.g., Peter's quiz reflection or Laura's problem-solving worksheet) with the expectation that these would spark student engagement in strategic and metacognitive learning approaches outside of class. Other activities, like Dana's process-oriented tasks, required learners to engage meaningfully with content and skills over time. All SRL-supportive activities were intended to be meaningful to students and, in one way or another, sought to engage the students in strategic action. Some instructors integrated SRLSPs like giving choice, opportunities to control challenge, and co-regulation in the implementation of activities they designed.

The four instructors I observed offered instructional supports and co-regulation such as modeling, demonstrating strategic approaches to problem solving, and using metacognitive questions in class. To greater or lesser extents, each instructor engaged their students in individual and social forms of learning and offered them opportunities to practice knowledge and skills. It seems that having autonomy over the course design and a flipped model of instruction enabled Dana and Vicky, respectively, to provide their students with regular and rich opportunities to engage in meaningful decision making and to control challenge. Nevertheless, instructors, like Laura, who had little autonomy over the course design, explored ways of giving students choices and opportunities to control challenge through an in-class activity.

In relation to supporting SRL through feedback and assessment practices, all the instructors offered students formative feedback during class, office hours, or in the discussion forum. Some of them (e.g., Dana and Mike), to greater or lesser extents, also offered process-oriented feedback in relation to assignments. While Laura and Vicky (and Peter) relied on one-time activities or occasional prompts to activate student metacognitive knowledge and skills, Dana offered students iterative opportunities to engage in self-evaluation and dialogue about learning processes.

Evidence showed that Dana and Laura integrated SRL supports in a cohesive way in their courses and created opportunities that combined multiple supports for students to control and manage their learning. For their part, Mike and Vicky chose to focus their SRL-informed teaching around instructional

supports and co-regulation in class, and/or through specific one-time SRL activities. Peter did not have the opportunity to try and assess, in real-time, his SRL-focused teaching practice like the other instructors did, but the process of inquiry enabled him to look at his practice through an SRL lens to identify and build on SRL supportive practices he was already embedding in his courses prior to participating in the study. Perhaps, instructors' autonomy over the course design, characteristics of their courses (e.g., size, level), or instructors' experience using learner-centred pedagogies, shaped the SRL supports that these instructors brought to their classes. Despite how instructors infused SRL supports in their courses, building SRLSPs takes time, and this study only represents one semester's worth of work. In our collaborations, instructors brainstormed and shared ideas and concreted plans to continue bringing SRL supports to future course offerings to build on their experience of teaching for SRL in my study.

Chapter Six: Instructors' Perceptions on Fostering SRL

In this chapter, I address the second and third research questions: how did instructors perceive supporting SRL in their undergraduate courses? And, how did students experience the SRL opportunities offered in their courses? With regard to the instructors' perceptions, I further asked: (a) how did instructors perceive the effectiveness of SRLSPs to meet the SRL goals they identified for their students? b) how did instructors perceive these practices made a positive difference in student participation and performance? and (c) what factors did instructors perceive as affording and/or constraining their efforts to supporting SRL in their courses?

Findings are organized in three subsections. In the first section, *Making a Difference: Engaging Students in SRL,* I report findings regarding the instructors' perspectives on whether or not their students took up the SRLSPs they offered and how effective they perceived these supports to be in engaging their students in SRL. Here, I include the perspectives of participating students in juxtaposition to what their instructors perceived was going on for the larger group of students in their courses. Hence, findings represent two different frames of reference; that is, the instructors focusing their reflections on all students enrolled in the course, and a small sample of students reflecting on their personal experience in each course. In the second subsection, *Making a Difference: Participation and Performance*, I report the instructors' perceptions about whether and how the SRLSPs they implemented made a positive difference in student participation and performance. In the last sub-section, *Affordances and Constraints,* I present factors that the instructors perceived as affording and/or constraining them to bring SRL innovations to their courses.

Making a Difference: Engaging Students in SRL

How did instructors perceive the effectiveness of the SRLSPs they brought to their courses to engage students in SRL? Evidence for this question emerged from the instructors' reports of informal observations they made during class time as well as in interactions outside of class (i.e., revealed in the CoI documents and meeting transcripts, classroom observation debriefs, and exit interviews). I also drew on evidence collected through students' interviews (Table 6.1).

Table 6.1

Student Interviews: Number of Focus Groups and Individual Interviews

Type	Laura	Dana	Mike	Vicky
Focus Group[1]	1 (A)	3 (B/C/D)	1 (E)	0
Individual	1 (a)	1 (b)	0	4 (c, d, e, f)
Total Students	3	7	2	4

[1] Two students per focus group; NOTE: The number in each column indicates the number of focus groups or individual interviews per course. The letters in parentheses are the labels I use to signal the student source of data in in the text.

Did Students Engage with the Opportunities They Were Given?

Across courses, the instructors perceived that, in general, student participation and approaches to learning in class were different to those of students in previous cohorts. They thought these differences could be related to the students' productive engagement with the SRL opportunities offered in their courses but acknowledged other factors could have accounted for these general observations (e.g., students would have participated anyways, they were better prepared).

All instructors observed that, in general, the students in their courses were more active in contributing to class discussions which they linked to having used a more dialogic approach to teaching (e.g., co-constructing knowledge). Vicky, Laura, and Dana observed that their students appeared to engage more deeply with tasks as they worked at their own pace in small groups and/or received guidance through metacognitive questions and peer support. For example, Vicky said: "[Class] felt chaotic but at the same time I looked around and people were engaged in their learning and they were trying, and they were making mistakes and fixing them" (classroom observation 1 debrief). Later in the study, she added: "Students were motivated in class, they wanted to finish the problems themselves before I demonstrated the solution which is not often the case" (Vicky, November CoI template). Mike and Dana shared how their students seemed to be empowered to share their opinions and engage with content or skills when their peers validated their efforts and supported them in whole-class discussions, small group work, or in office hours. The students in Dana's course who participated in the study mentioned they valued SRL-

focused tasks as timely opportunities to take control over their learning. One student said: "I'm trying to enter grad school and I've figured that SRL is a huge part of it, you need to know how to teach yourself, so I took [the reflection assignment] seriously [be]cause I wanted to get something out of it".

Dana, Laura, and Mike linked their students' more deliberate approaches to tasks and learning to their uptake of SRL supports. In a personal communication (October 13, 2017), Dana shared how her students engaged with discussions about SRL in class:

"Today at the start of class one student asked if I could explain how she could tell whether she is a self-regulated learner... so we ended up spending 6-7 minutes talking about the cycle of strategic action and times when we failed at one of the steps. Another student was surprised that some people may not switch strategies when things are not working out and commented: 'Isn't it what learning is all about? When you get a midterm back and it wasn't good you know that you have to do something different next time'."

When looking at their students' work, Laura observed some students used the vocabulary and approaches to problem solving she had been modeling in class, and Mike noticed his students seemed more critical about approaching math proofs than students he had taught in previous cohorts.

Despite these descriptions of their students' productive engagement with SRL opportunities, Vicky, Laura, and Mike noticed that the effects of SRL supports were short-lived for some students, did not reach the entire class, or were simply ineffective. For example, in our December CoI meeting, Vicky mentioned how the in-class reflection midterm in her course was effective in the short term. She said: "I feel like I saw uptake, like a change in behaviour, but it wasn't extended. It was short and then students went back into their old routines. The uptake wasn't long enough for them to feel or see results to encourage them to continue with [engaging with pre-class materials]." She extended this idea in the exit interview: "I stopped doing [reflection questions at the beginning of each class] because I found that it became mechanical, students did not care about the answer, they just answered. I felt it stopped working." Mike observed that asking metacognitive questions and inviting students to contribute to class discussions

had been effective to hear contributions from more students than usual but still some students did not participate as he would have liked. For her part, Laura noticed that some SRL supports such as modeling or demonstrating were not enough to change students' practice on their own.

Factors Influencing Student Uptake of SRLSPs. During our discussions in the CoI, three influencing factors surfaced in relation to student uptake of SRLSPs: (a) student typical behaviours (as perceived by instructors); (b) student expectations of and experience with undergraduate teaching and learning; and (c) the value students give to grades. With regards to student typical behaviours, all instructors commented during our November CoI meeting how they observed that some of their students tend to jump straight to writing or working problems and drawing conclusions before reading instructions and understanding the task at hand. For example, Mike and Dana observed that some of their students did not use strategic approaches to problem solving or did not take the time to understand the questions in midterms, they just started writing what they knew. In the second classroom observation, Laura noticed that her students ignored a choice she offered in one of her activities —to decide which set of problems were most useful to work on (i.e., review content, practice problem solving, or apply knowledge and skills to new situations)— and just started solving the problems in order.

A second factor that the CoI identified had to do with students' expectations concerning the delivery of content in the context of science, which are often based on their own or their peers' experiences. For instance, in our December CoI meeting, the instructors agreed that incoming students to the Faculty of Science often expect to learn from instructors rather than from peers, as well as to be engaged in tasks and evaluation processes that focus on outcomes, completeness, and accuracy instead of process. Dana's words in the final interview illustrate this tendency for Science students to not expect to engage in learning-how-to-learn activities: "Students are maybe taken by surprise when they're taught other things than content … in Science especially. [Reflection] is not something that they do." As a CoI, we interpreted that the expectations students have about how teaching and learning at university looks could influence the value they assign to SRL-focused tasks and their engagement in SRL supportive opportunities. Vicky mentioned how some of her students were not taking up her prompts to engage in

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strategic problem solving: "It would help the people that don't really have strategies to hear other people's strategies, but they didn't get it! They said: 'I just want to solve the problem. I can't explain to you how I get unstuck'" (November CoI meeting). Perhaps the students engaged briefly, or not at all, with some SRL opportunities because they needed more time, consistent and meaningful opportunities for applying strategies to their learning, or perhaps because they did not know how to engage in process-oriented tasks. In my talks with some of the students in these courses, they mentioned that classes were fast-paced and they chose to engage deeply with content, not process, because that was what was assessed.

Lastly, in our November CoI meeting, the instructors recognized that grades and evaluation procedures drove students to value and engage with tasks in general, and perhaps with SRL opportunities. For example, Mike commented that students in his course were engaging with the scaffolds mostly "because they realized that if they weren't critical about the process they would fail [the midterm]." He added: "The only thing that motivates [students] is grades. If you say, 'I'll give you marks on the exam for filling in the blanks of that scaffolding, for your solution, for your plan.' … that's the way to [engage] them" (November CoI meeting). Nevertheless, Dana shared she had a different experience. She was surprised that her students took up the opportunity to submit cumulative drafts of their final project even when there were no grades attached to the drafts. Dana thought that advanced students might find these process-oriented tasks instrumental to their learning. One of Dana's students expressed to me: "If you're not specifically asked those questions [e.g., what is not going well?] it might just be a thought in your head but not necessarily something you act on. I can make a goal from [my reflection]" (student interview b). This student recognized the reflective activity as an opportunity to stretch her learning.

Adapting Teaching Practice in Response to Student Uptake of SRLSPs. When each instructor I observed perceived that the SRLSPs they implemented were not taken up as expected (e.g., when the effects of their efforts were short-lived or when they did not see their students changing their approaches), they adapted (or thought about how they would adapt) their SRL goals and/or teaching practice and/or reached out to their students to gather feedback. If class time allowed, their follow-ups seemed sufficient to motivate their students to take up SRL opportunities. As Dana mentioned in the exit interview:

"Sometimes they would disregard [instructions] and not [discuss task understanding as a group] … we would check in with the answers and for someone who had misinterpreted the questions I'd ask: 'So did you check with your neighbor that you understood the question?' And they said: 'Oh no!' They worked on interpreting it and then said: 'When it's an exam I have to make sure that I understand the question'." For Vicky, Mike, and Laura, metacognitive questions addressing small groups and or the class as whole were useful to redirect their students to engage productively with learning.

Vicky and Mike made minimal changes to their SRL teaching practice during the academic term (e.g., Mike offered students extra exercises so they could practice strategic math proofing approaches outside of class), but they planned how to enhance what they had done and ways to embed new SRL supports in future course offerings. Laura and Dana, on the other hand, tweaked specific activities and perceived that on some occasions, these adaptations were effective to engage their students in SRL. For example, in our November CoI meeting Laura expressed: "… when I did my first bit —[metacognitive Mondays]— and felt that it didn't have any impact, I thought rather than having a bunch of different things that didn't have impact, it might be better to just hit one thing especially." As a result, Laura tweaked her lectures to include modeling and demonstrating. When these additions to her teaching still did not motivate her students to use strategic approaches to problem solving, she tried to instead integrate different SRLSPs in an in-class guided practice activity. She perceived some aspects of that activity (i.e., metacognitive questioning, peer-to-peer support) were more effective than others (i.e., choice) to engage students productively, but this encouraged her to keep thinking how to continue embedding supports in future course offerings.

Laura and Dana also adapted their teaching by sharing the rationale behind their SRLSPs with their students hoping that they would find SRL supports more relevant to their learning and engage with the SRL opportunities offered. For example, Laura met one-on-one with a student who had emailed her complaining about the worksheet activity they did in class because she and her peers could not solve most problems without an answer key. Laura said: "The student left [the meeting] having more confidence and with a better idea of what was expected from her when I explained that [knowing how they verified their

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solutions] was how I could see an effect in [students'] performance" (December CoI meeting). Some of Laura's and Dana's students I talked to said knowing why instructors were implementing SRLSPs was perceived as helpful to guide their learning and uptake of these supports. However, despite understanding the rationale behind the practices, some students did not fully understand how to engage with the activities.

Perceived Effectiveness of SRL Supports

In Chapter 5, I discussed how the instructors used several SRLSPs to engage their students in SRL. These SRL supports were either embedded in one-off tasks (i.e., implemented and completed at a single point in time), in more complex tasks (i.e., extending across time/iterative), or as instructional routines. In our December CoI meeting, the group agreed that the way that SRL supports were implemented influenced their effectiveness on student engagement in SRL.

Laura and Vicky tried implementing SRL supports as one-off tasks (e.g., Laura's problem-solving worksheet and Vicky's midterm reflection). Interestingly, both perceived these SRL activities were ineffective in fostering student engagement in metacognitive thinking and strategic learning or only effective in the short term. When reflecting about the problem-solving worksheet activity that she brought to her course, Laura said: "… one session isn't going to be enough to make them comfortable with not knowing how to solve a problem … metacognitive skills take a long time to develop" (classroom observation 2 debrief). When I spoke with Laura's students about this SRL supportive activity, their reviews were mixed. Some of Laura's students perceived that the activity was overwhelming and useless to enhance their understanding about problem solving, specific content to be learned, or themselves as learners. One of them said: "It destroyed my confidence … I didn't understand how to do any of the problems, and [Laura] never posted solutions because she thought it was more important for our understanding. I'm like, 'Yes, but I don't get any of them, and I'm freaking out'" (focus group A). Other students from Laura's class felt they could engage with this activity but said Laura's goal to support the development of problem-solving verification strategies was not met because they did not have enough support to monitor their performance. By this, they meant the answer key. In the final CoI meeting, Laura

and Dana suggested that one-off activities may not work because introducing challenging content along SRL processes, which students are not familiar with, can be overwhelming for them.

Mike, Vicky, and Laura consistently used scaffolds in class (i.e., modeling, metacognitive questions) and Dana implemented SRL supportive activities iteratively (e.g., reflection, collaborative activities). In the final interview, Dana mentioned that the way she implemented SRL supports in her course fostered student confidence to participate in class as well as student engagement in strategic and critical thinking about the subject matter. Building on these experiences, the instructors agreed in the final CoI meeting that guiding students to engage in SRL was more effective when SRL supports were part of a routine (e.g., Mike's or Vicky's scaffolding) or were embedded in regularly occurring more complex activities over time (e.g., multiple reflection assignments or collaborative learning in Dana's class) rather than through one-off activities (e.g., midterm reflection). In our last CoI meeting, the instructors agreed that for students to take up SRLSPs, time and consistency—within and across courses— were essential.

Modeling, Demonstrating and Offering Opportunities for Practice. Our CoI discussions led the instructors to believe that only lecturing about and modeling strategic problem solving had potential to enhance student metacognitive knowledge, but it was not enough for students to transfer that knowledge to skills and actions. Laura's words illustrate this idea: "Just saying something doesn't mean that the students internalize it, and if what we're trying to work on is skill building, you can't just shot-gun a bunch of information, you have to go deep" (exit interview). Her students' reflections were congruent with this idea. They described how lecturing about how to approach problem solving was useful to understand the importance of the process, but "I didn't actually learn how to problem solve from it" or "I didn't fully understand how to replicate that myself" (focus group A). Vicky talked about how pairing modeling (i.e., how to actively watch pre-lecture videos) with activities that invited her students to think about their lecture preparation approaches seemed more effective than just telling them how to prepare for class (classroom observation debrief 1). Vicky's students who I spoke with mentioned that the midterm reflection piece was the aspect that made them either change (students' interviews c and e) or keep their approach to preparing for class (students' interviews d and f) to improve or maintain their performance.

Through modeling, demonstrating, and offering opportunities for practice in and out of class, each instructor I observed, sought to enable their students to apply their knowledge flexibly, gain confidence as learners, and acquire productive approaches to learning and exam preparation. They perceived that these practices were effective to meet their goals because, in general, students displayed confident and adaptive uses of knowledge in and out of class (e.g., contributions to web discussion boards, assignments, and exams). For instance, reflecting about her SRL-focused teaching practice, which relied on modeling, demonstrating, and guiding student practice in class, Vicky said: "I think that's really where all the learning happened, getting them involved in the process got them to the point that I wanted them to be" (exit interview). One of Vicky's students described her lectures as student-centred: "She showed you rather than told you" (student interview c). This student found this approach to be different from the other lectures he attended and productive for him to actively engage in learning. Other students I spoke with also reflected on the effectiveness of modeling and demonstrating to build their confidence in dealing with content in and out of class. For example, one student from Laura's class said: "I liked working through the examples … [Laura] would start her work and I would think that I got the answer wrong, but really we just went a different way to find the same answer" (student interview a). On the same subject, another student commented: "I appreciated the idea of problem solving and going through these mechanical steps … it was my thought process throughout the midterm and the final" (focus group A). For these students, Laura's instructional supports were effective to build more strategic and deliberate approaches to learning.

Dana observed that SRL-informed authentic activities as in and out of class opportunities for practice were effective to foster deep and strategic approaches to learning. For example, she mentioned her students chose to explore advanced experimental techniques when she invited them to learn through research with the purpose of sharing their new understanding with their peers. In relation to this particular activity, one of her students said he felt motivated to work on this task because he was responsible for learning a technique but also for teaching it to others, "which made it self-directed learning. I was learning a lot more actively" (focus group B).

Engaging Students in Strategic Action. In each course I observed, the instructors found the cycle of strategic action useful to guide student learning. Mike, Laura, and Vicky emphasized different aspects of the cycle (e.g., task understanding, planning, and monitoring) as they taught problem solving while Dana used the cycle to engage her students in productive collaborative work (e.g., to support shared task understanding, or to help with negotiating roles). These four instructors perceived that using the cycle to guide learning was effective to build their students' confidence with the subject matter and to foster autonomy and flexibility with knowledge use. For example, Mike mentioned:

> "It seems they felt more courageous this way … the starting point usually scares them off a little bit, makes them uncomfortable, and leading them with more steps made them more comfortable with the whole process … [students] were more susceptible to understanding how to lay out a problem or how to approach a problem when they saw one" (exit interview).

Nevertheless, Vicky also observed that students needed reminders to take such an approach in their out of class learning; she said: "Students won't use SRL practices when they have more urgent matters to deal with" (December CoI template). In our final CoI meeting, the instructors agreed that students needed more opportunities for practice and timely support to be able to learn well and apply acquired SRL skills (e.g., planning, identifying and enacting strategies) in the service of learning.

Most of the students I spoke to also perceived that strategic problem solving was effective to give them control over their learning; and to this end, they identified long-term effects linked to it, especially when they learned from misunderstandings, errors, and other people's strategies. For instance, one of Mike's students said:

> "Breaking things into steps helps your brain think about how to work through the problems … there were times when I first thought, 'I have no idea how to do this,' but then I would say, 'What's the first step, what do I do next?' You feel less stuck, it's more manageable … When there was a mistake, he took the time to explain why … actually knowing the wrong way and why it was wrong was really helpful" (focus group E).

This student added that Mike's scaffolding made it easier for her to apply that knowledge on her own when studying, doing assignments, and writing midterms. On the other hand, some participating students across courses perceived that while in-class scaffolds for strategic problem solving enabled them to recognize different ways to approach problems, sometimes the scaffolds were either too detailed for simple questions/problems or the process seemed slow for some advanced students. One of Vicky's students commented: "I think [guided strategic problem solving] was helpful for those who didn't have experience with coding, but I already knew some coding …but sometimes I still had misunderstandings about programming so [Vicky's guidance] helped me" (student interview f). Likewise, some students in Dana's class perceived that engaging in collaborative strategic action (i.e., task understanding, planning) was more productive in high stakes situations like a group quiz than in simpler collaborative tasks in-class.

Planning and Reflection Tasks. Dana, Vicky, and Laura observed that their students acquired insights about themselves as learners and gained vocabulary to talk about learning through their engagement in planning and reflection activities. For example, Dana shared that one student mentioned in her reflection that she dreaded group work but said: "It was good to just face it and do it and realize that it's actually just something that you can get used to" (exit interview). Dana also shared that her students' reflections about themselves as learners were very rich: "They articulated their strategy or what they thought was going to be a challenge so well that you could tell they thought of it … and sometimes it wasn't a standard thing that they thought was going to be challenging" (September CoI meeting). When Dana, Vicky, and Laura had the opportunity to hear their students' voices through planning or reflection activities, they learned that their students were aware of some of their strengths and weaknesses in relation to learning. For example, students in Dana's course recognized what they could bring to group work, recognized barriers to their learning, and identified strategies to be successful at tasks and overcome hurdles. Laura and Vicky perceived that the reflection activities they implemented did not enable them to evaluate whether their students were being metacognitive or not, or how it would influence their students' approaches to learning going forward. In our last CoI meeting, the instructors

agreed that attaching the word 'reflection' to process-focused self-evaluation tasks might discourage students from engaging with reflection activities; particularly for students who might not be ready to reconsider their learning processes or habits.

The students' perceptions about the effectiveness of planning and reflection activities were mixed. Some students recognized that planning and reflecting assignments were meaningful and useful because, through the task, they became aware of areas of competence (e.g., productive study habits) and areas they needed to work on to take control of their learning. For some students, this awareness translated to action. For example, one of Dana's students commented: "[If it had not been for the planning assignment] I probably wouldn't have taken the time to think about the best way to approach [the project]. Then, she added: "I would've just started rather than planning … when I did the project, I followed the steps, and it went smoother than it might have otherwise" (focus group D). Similarly, one of Vicky's students described how when she saw the midterm reflection questions, "[she] realized that [she] needed an organized plan to follow, how to use the time, so [she] made that plan for the final" (student interview f). But for other students, this increased awareness did not translate into action. In relation to the midterm reflection activity, one of Laura's students said: "[It] gave me confidence when I realized that I got full credit for almost every question I answered … but my mistakes related to not understanding or knowing how to solve the questions … I couldn't do anything about that" (focus group A). On the other hand, some students thought planning or reflecting activities implemented in their courses did not add to their learning experience because it was a habit they already had (e.g., they revised midterms and adapted their studying approach based on performance and feedback).

Dana used planning and reflection activities throughout the term and perceived them to be helpful opportunities to enhance her students' understanding of themselves as learners and to foster a growth mindset (i.e., learn from errors). For example, Dana acknowledged: "Some students opened up about their struggles, strategies, failures …" (December CoI template). She noted that students used SRL language in their reflections and evidenced their metacognitive thinking when they identified how they were making progress, what strategies had worked, which ones did not, and why. In this course, some students thought

the way reflective assignments were implemented influenced their perceived effectiveness to foster growth in learning. For example, they identified that reflecting as a group, reflecting only once about something, or having few opportunities to apply what they had learned through reflexive exercises (what worked; what did not work and why) hindered the opportunity to learn about themselves as learners.

Choice and Control Over Challenge. In relation to the effectiveness of choice and control over challenge, the instructors' perspectives varied. For example, Laura noticed that offering students the opportunity to decide which type of exercises to work on depending on where they were at in their learning was not effective. Referring to the activity in which she embedded choice (i.e., problem-solving worksheet), Laura said: "Despite my encouragement, I worry my 'desirable difficulty' exercises are causing them to despair" (December CoI reflection template). She observed that her students still tended to work linearly through the problems on the worksheet. Some of her students confirmed that they disregarded the opportunity to select problems while others said they could not make sense of this part of the activity. One student said: "[the choice] was disorienting, I was not solid on my previous knowledge … how was I supposed to be able to come up with all of this out of nowhere?" (focus group A). Not having enough background knowledge was also perceived as a barrier for some of Dana's students when they were given the opportunity to make informed and strategic decisions about their learning too early in the term (e.g., being asked to choose a topic for final project in the second week of the course). In these cases, choice did not enable students to recruit, nor enhance, their metacognitive knowledge and skills in the service of engaging with learning activities.

For their part, Vicky and Dana found that engaging their students in decision making and controlling challenge was effective in helping them realize that they could regulate their learning. For instance, Vicky observed that, in general, providing opportunities for her students to take a deliberate approach to learning (e.g., making choices, controlling challenge) was effective in informing them about how they needed to prepare for class. Students in Vicky's class perceived that being able to choose from different resources (e.g., textbook, internet, notes, teaching assistants and Vicky, peers) and to work at their own pace through worksheets enabled them to identify and use strategies that worked for them. One

of Vicky's students said: "It was a good opportunity to discuss with my friends and deepen our understanding, but the first eight weeks I worked on my own because [the content] was easier" (student interview f). Another student also commented: "I had freedom to manage and find the most efficient way [to work on the worksheets] … the way I was most comfortable with … I figured what worked best for me" (student interview d). Likewise, Dana observed that inviting her students to decide whether to submit drafts of their final project for feedback or choose a topic for the final project was effective for them to stay on track and feel motivated for learning. One of Dana's students enriched this observation, saying that: "Drafting was definitely useful … there is that lack of motivation when you don't have due dates set. You just won't start it early enough. You just say: 'I don't need to worry about that until November'" (focus group D). In relation to having the opportunity to choose a topic for the final project, one of Dana's students said: "You're free to choose what you learn and your attitude going into it is not, 'I have to learn it because of the good grade but instead I want to learn this and to do this thing [project] that could possibly give me a good grade'" (focus group B).

Metacognitive Questions. Evidence showed that each instructor I observed also perceived metacognitive questions (e.g., "How do you think you can approach this proof?", Mike, classroom observation 2; "How could you verify that it's correct?", Laura, classroom observation 2) were effective in empowering their students to regulate their learning and build their sense of competence. For instance, after the first classroom observation, Laura said:

> "[Students] have seen me model problem solving but are slow to take the methods up
> themselves. They're very reliant on appeals to authority to assess their understanding, so
> it was nice to be in a position where the authority is telling them directly that they can
> figure out whether or not they understand."

The students who shared their perspectives with me were mixed in their opinions about the efficacy of metacognitive questioning. One student in Laura's course perceived these questions were useful, noting that: "The questions [Laura] asked during tough problems helped me become a more active learner because I had to think about what the hint was and apply it instead of just waiting for the answer"

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(student interview a). However, other students I spoke with mentioned the metacognitive questions were too vague when they did not understand the topics.

Engaging Students in Social Forms of Learning. In our last CoI meeting, the instructors agreed that engaging students in social forms of learning (e.g., co-constructing knowledge, collaborative work) in class was efficient for students to support and inform one another. In addition, Laura, Dana, and Vicky found that having their students work in small groups enabled them to walk around the classroom and offer timely support, a practice they perceived was effective to guide students towards independent learning.

The instructors and students alike perceived that co-constructing knowledge as a class, or in small groups, motivated students to be better prepared for and participate in class, and stretched their understanding of the subject, particularly when students perceived their classroom as a safe atmosphere. Vicky mentioned that having created a safe space where students could contribute their ideas and learn from one another had been quite effective: "I feel like the engagement was high there because they wanted to see a solution and they wanted to compare their work to that of their peers" (exit interview). Nevertheless, she acknowledged that co-constructing knowledge as a whole class took time. On the same subject, one of Dana's students said: "Everyone had a chance to contribute in class and it felt homey … everyone felt comfortable sharing" (student interview c). Echoing this sentiment, another student said, "… the way the course was designed was very low risk, you could ask a lot of questions and actually think about stuff and learn without worrying about getting the right answer right away" (focus group C). Other students offered that co-constructing knowledge in class helped them think critically about the subject matter. For example, one of Mike's students said: "[Co-constructing knowledge] was helpful because I think it got me to think in the right way to solve the problems versus just memorizing the steps and then trying to redo it" (focus group E). Lastly, students in Vicky's class highlighted that co-constructing knowledge boosted their confidence: "Giving people the opportunity to try and share other paths and realize if it works or not … you feel good about seeing your work shown as an example in the classroom" (student interview d). In our last CoI meeting, the instructors concluded that creating a

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positive space for learning, where all contributions were valued and encouraged, was effective to give students ideas about how to approach future problems, learn from their own and others' mistakes, and form a community of learners to rely on.

However, the students' perspectives about collaborative work were mixed. In Dana's course, some students I spoke with mentioned that learning with and from others was the aspect of collaborative work that participating students found most useful to stretch their thinking and approaches to learning. For example, they perceived working with peers was effective in aiding problem interpretation and for monitoring their understanding. One of Dana's students said: "[Taking time to develop a shared understanding of the task] helped you get on the same level with other students, make sure you were talking about the same things" (student interview b). Similarly, other students in Dana's class mentioned that working collaboratively enriched their understanding of the subject matter and helped them think more creatively about it. One student said: "[Collaborating] facilitated us talking about the task in general rather than the specific answer to the question … having the freedom to talk to other people about specific topics in the course." This same student added: "That's where I did most of my learning … listening to other people's ideas of how to solve problems helps you think more, and you start getting creative and thinking outside the box a bit more" (focus group D). On the other hand, some students found that working in small groups enabled them to finish work on time but did not stretch their learning. This sentiment was clearly expressed by one of Laura's students: "I did [the first section] in class with my friends and that was fine. I don't know how much of it was because my friends were helping me or because I could actually do it or not" (focus group A).

Making a Difference: Participation and Performance

How did instructors perceive SRLSPs made a positive difference in student participation and performance? Answers to his question surfaced when instructors recorded their reflections about informal observations they made during and outside of class, about their students' performance in course requirements, and/or about comparisons to students they had previously taught (i.e., revealed in the CoI documents and meeting transcripts, classroom observation debriefs, and exit interviews).

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Across cases, the instructors observed the SRLSPs they implemented in their courses had, overall, a positive impact in student participation and performance. They recognized that being part of the study and using an SRL lens to teach made them more attentive to indicators of participation and performance than they have been in the past. Dana remarked that: "I've had other very nice cohorts, but this one was particularly good. I wonder if it's connected again to the fact that I started seeing the students work differently and I was being less directive" (exit interview). Table 6.2 summarizes areas of participation and performance in which at least one instructor perceived students showed positive changes.

Table 6.2

SRLSPs Impact on Student Participation and Performance

Level	Area	Comments	Instructor
Participation	Attendance	Student attendance was higher	L, D, M, V
	Contributions to discussion	Students participated more in class, showed deeper engagement with content (e.g., strategic thinking, richer contributions, higher quality questions)	L, D, M, V
		Students offered higher quality contributions and more meaningful peer to peer support in web-based discussion boards	L, D, M, V
	Engagement in activities	More productive (e.g., students worked independently, required less prompting, help seeking was more focused)	L, D, M, V
		Students submitted more assignments (including ungraded ones)	D, V
Performance	Assignments Midterms Final projects	Students showed better/more critical understanding of course materials, expressed knowledge more clearly, showcased their thinking process	L, D, M, V
		Students developed and demonstrated "expert-like skills"	L, D, M, V
		Higher grades	D, M, V

L = Laura; D = Dana; M= Mike; V = Vicky

Participation

When comparing the cohort of students enrolled in their focal course to previous/other cohorts, all of the instructors observed higher attendance and more participation both in and out of class and in assignments. For example, Vicky shared in the exit interview that: "Definitely this cohort was more

engaged with higher participation in class and more [students] were working at different paces through the worksheets with fewer students needing my prompting." She added: "… For the most part I had really high attendance, compared to other direct entry sections where they just didn't come to class." Vicky, Dana, and Mike perceived that having created a safe space and a community of learners had a positive influence on student participation.

Dana, Vicky, and Laura not only observed their students participating more frequently in class, but they also observed more students working productively and independently in class and contributing to in/out of class discussions. For example, Dana observed how some students were silent for half of the semester but when they started contributing, it was hard keeping them quiet. She was also surprised to see how students in this cohort "seemed much more comfortable if they didn't know something right away [in an in-class group work task]. They figured it out instead of waiting for me to help them. Normally in those classes I was just running around like crazy because they all needed help" (exit interview). Another general observation from these three instructors was that when their students wanted to engage with in-class activities but were unsure of the process, they asked for guidance more so than students had done in previous cohorts. In the exit interview, Dana shared that after the first time she talked to students about group work, there were two students who approached her. One of them said: "I'm really uncomfortable with other people around but I still want to participate, what should I do?" Another student said: "I feel I don't have the skills to help." Dana interpreted these revelations and chatted with them about group work roles and how each member of the group brings different skills.

Across courses, the instructors perceived their students were grappling with content more deeply as evidenced by their questions and contributions in class. For example, Mike noticed that scaffolds in his class seemed to help his students in approaching and thinking through the proofs: "The way they participated in class changed … when we had discussions, they were more on the right path … their assumptions, what they wanted to show and where they wanted to go were better organized" (December CoI meeting). In the exit interview, Mike added: "[Students] came up with thoughtful questions on

[relevant] topics. Usually, they only ask questions about the finals or midterms … they had ideas and they criticized those ideas, which pushed the lecture beyond what I was teaching" (exit interview).

Laura's perspectives revealed her perception of the impact of SRLSPs in out of class student participation and quality of peer support. Laura shared that as she began "nudging" through questioning as opposed to giving answers on the web platform discussion forum, she noticed that her students commented more and offered support to peers: "Instead of what they would usually do, which was just: 'Oh! you differentiate [direct answer] …' they went step by step. They were giving much better answers and a lot of them were also using that sort of Socratic questioning" (exit interview). This higher-quality peer support (process-oriented and with accurate language) was reflected in fewer students making use of office hours. Mike also noticed his students offering high quality support to peers during office hours:

"One student asked me a question first, and I helped him. Then somebody else asked me the same question and I said, let him explain it to you. This student just got the board and started writing and explaining everything. His peers were mesmerized about how simple the question actually was … he was incredibly methodic at doing the problem: '… this is what I want to show, this is what I have, this can be the next step, this should be next step ... try to keep in mind where you want to end, what you want to show, the rest is just algebra'" (November CoI meeting).

Lastly, Dana and Vicky noticed their students completed and/or submitted more assignments, even those that did not have a mark attached. For example, in Dana's final project, students had the option of submitting an outline that did not contribute to their grade but was useful to receive formative feedback. In the exit interview, Dana mentioned she was very impressed with her students submitting this optional work: "This was the first time that everybody handed it in, maybe a couple of people were late. Normally, less than half the class hands it in. It's possible that [the planning activities] enabled them to do it on time" (exit interview).

In one way or another, the instructors across courses perceived that during the term in which they purposefully brought SRL supports to their courses the quality of student participation and engagement

with course activities (e.g., attendance, homework assignments, class and web platform discussions) was better.

Performance

Across courses, all four instructors reported that the quality of work submitted was better compared to other sections/cohorts they had taught in the past, as was reflected by higher grades on assignments, midterms, and final projects. For example, Vicky observed higher midterm averages on the first midterm compared to the previous year's cohort, as well as an increase in performance between the two midterms. She thought the reflection and discussion they had as a class after the first midterm influenced student pre-lecture preparation and engagement in class, which led to better grades. She commented that: "Some people that failed went to 90+%, just big jumps, some people dropped too .... But there were quite a few people that went up, so I think that maybe they started practicing more and actually doing things in class" (Vicky, exit interview).

While Laura and Mike did not grade assignments, their teaching assistants informed them about student performance. They mentioned that their teaching assistants reported that students were going beyond just providing responses to problems to showcasing their thinking process (unrequested) and expressing their understanding of course materials more clearly. Mike mentioned that the grade average on the midterm for students in this offering of the course, compared to students he had taught in the past, was higher and these students "were doing better at realizing their mistakes and approaching them in the right way. They seemed better at thinking critically and having productive ideas" (exit interview). Laura and Mike only marked single questions in anonymized final exams across course sections, and course grades were submitted after exit interviews were conducted. Being removed from the marking made it difficult for these instructors to draw conclusions about whether the quality improvements they observed in assignments or the midterm translated to better grades at the end of the term.

Of the four instructors who were actively teaching during the study, Dana was the only one who designed and graded all assignments and evaluations. She reported that "in terms of performance I think the students did very well compared to last year's class who also dealt with the same data set and

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questions" (classroom observation 2 debrief). When talking about the reflection assignments, Dana mentioned that even though she implemented somewhat similar reflective assignments in previous years, the cohort she had during the study "scored at top level pretty much. They just put more thought into it and were more on target with their answers" (exit interview). In relation to the final projects, she mentioned in the exit interview: "What I marked so far, they were doing really well, especially considering that some of this stuff was harder. I saw they were doing so well that I kind of challenged them a bit more." Dana mentioned that her students not only paid attention to all elements of the project, but also showed critical and creative thinking around the topics of choice; they took the project above and beyond expectations.

Evidence showed that the instructors who were teaching during the study observed positive changes in their students' participation and performance. Importantly, they noted that their students started to develop and demonstrate meaningful 'expert-like' skills in class, assignments and/or evaluations, such as knowing when a product is good enough (e.g., Dana's students), how to fix mistakes (e.g., Mike's and Vicky's students), how to analyze problems (e.g., Laura's and Mike's students), and how to identify which type of practice they needed to engage with to be more successful (Dana's students).

Affordances and Constraints

What factors did instructors perceive as affording and/or constraining their efforts to supporting SRL in their courses? Findings reported in this section surfaced in classroom observation debriefs, CoI reflection documents and meetings. Evidence gathered in the study suggests three levels of influence that facilitated and/or constrained instructors SRL innovations and applications to their courses: system, student, and instructor. Although these levels of influence and factors associated with them are interrelated, I address them separately in this section. Table 6.3 summarizes the themes that emerged within these three levels of influence and provides examples of how instructors perceived these themes as an affordance and/or a constraint.

Table 6.3

Affordances and Constraints for Bringing SRL Supports

Level	Theme	Affordances	Constraints
System	Course structure and discipline/department culture	- Advanced courses - Small classes - Course design - Supportive colleagues	- Multi-section courses - Large classes - Traditions/expectations
	Time	- Out of class interactions with students	- Limited class time - Short academic term - Discontinuity
	Evaluation structures and policies	- Instructor involvement in design and process	- Imposed structures - Grading practices
	Technology	LMS[1], clickers	- LMS[1], clickers
Student	Paradigm Shift	- Openness to new learning strategies and contexts	- Lack of awareness about needing new learning strategies/resistance to them - Poor skill transfer - Expectations about tasks
Instructor	Competence	- Knowledge about SRL - Involvement in scholarship of teaching initiatives	- Limited SRL knowledge - Lack of follow through
	Beliefs about teaching and learning	- Feeling responsible for teaching how to learn - Believing they can make a difference - Reflecting about teaching practice	- Feeling limited responsibility for teaching how to learn - Interpretations of student expectations - Perceived lack of control over classroom culture

[1] Learning Management System

System

Although in different ways, all instructors alluded to a variety of interrelated systemic factors that influenced their capacity to infuse their courses with SRL supports, including: (a) course structure and culture, (b) time, (c) evaluation structures and policies, and (d) technology.

Course Structure and Discipline/Department Culture. Course level, size, type (e.g., multi-section) as well as disciplinary/department curriculum and learning traditions played an important role in

the instructors' perceived autonomy and capacity for bringing SRL supports to their undergraduate courses. For example, Dana perceived that her context (i.e., an upper level, small, one-section course) afforded her greater leeway about how, when, and why to infuse supports for SRL both in and out of class. Nevertheless, she pointed out that infusing SRL practices was sometimes challenging due to established course/departmental/discipline learning traditions and expectations. Mike echoed this idea, mentioning that active participation in math lecture courses is unusual which acted as a barrier to bringing the SRL innovations that he designed to his course (classroom observation 1 debrief).

Instructors teaching introductory (i.e., Laura and Vicky) or intermediate (i.e., Peter and Mike), large, multi-section courses perceived their context as more restrictive to infusing with SRL supportive practices. For example, in our December CoI meeting, Laura expressed that developing a strong relationship with students in large introductory classes (~200 students) was challenging. She noted that it led to instructors losing control over the class culture, with peers having more influence over time. She explained that after a few weeks in the course, peers relied on one another with a focus on obtaining a good grade while disregarding her guidance for learning productively. Likewise, Peter (December CoI meeting) said: "If I wanted to allocate more emphasis in the course on certain practices, in class or even change on my homework, that isn't necessarily possible in a lot of these big courses, but it is a matter of course design." Dana also recognized that multi-section courses may be particularly limiting to bringing innovations because when students compare content, assignments, and teaching style across sections, they get worried "… if they realize that their friends in a different section do something different, they'll panic because they think that now, they won't be prepared for the exam." These ideas were echoed by others in the CoI. However, Laura pointed out that despite these limitations, some introductory courses are designed in a way that makes it easier to embed SRL innovations. For example, in her course, the textbook and some homework assignments encouraged students to think about and use concepts flexibly.

All instructors noted the role teaching colleagues could play in supporting or hindering their efforts at bringing SRL supports to the course. For example, in our December CoI meeting, Mike shared his experience with colleagues: "[In a course meeting] I said just a couple of things [SRL related]. The

instructor in charge was like, 'Why don't you do the things the way we're used to doing.'" However, Laura shared an experience that contrasted with Mike's. On that same meeting, she described working with supportive/like-minded colleagues: "Even though I don't have much autonomy, the other instructors are very keen on [SRLSPs] … when we wrote the final [exam] everyone was on the same page: 'We need to test concepts, to think about problem solving skills …'" The instructors agreed that having a community of colleagues open to seeing teaching and learning through an SRL lens encouraged them to infuse their courses with SRL supports.

Time. Time was a factor that all instructors consistently highlighted as constraining their efforts at bringing SRL supports to their courses. Across courses, all instructors mentioned the number of classes (i.e., contact hours) in the term and the amount of time in each class were limited relative to the volume of material they had to teach. This reality hindered the possibility of including aspects like explicit teaching of SRL, embedding SRL in activities during class, or focusing on whether and how students were taking up these opportunities. In our December CoI meeting, Mike addressed this constraint: "The class times and the material that has to be covered doesn't give us so much time to kind of do whatever we want and however we want to do it." All instructors perceived that engaging their students in activities designed with SRL in mind (e.g., planning or reflection) took time away from content delivery and that students needed a lot of support to engage productively with these activities. Dana highlighted the need for longer sessions: "I wish we had more time … students said they wished we had two 80-minute sessions instead of three 50-minute sessions … we could do an activity, look how it went, debrief, discuss versus being rushed and leave half-way behind" (exit interview). This sentiment was shared among the instructors.

Even though class time was limited, Mike, Laura and Peter perceived that out of class time was when they could see their students' engagement in SRL, such as immediately before/after class or during office hours (i.e., through the type of questions they asked or the language and steps they used to walk through problems). They pointed out that these out of class interactions were when they observed their students' thinking was influenced by SRL innovations; as a result, they were encouraged to continue

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bringing supports into their courses. Laura gave an example of such an interaction in our September CoI meeting:

> "I had one student who stayed after class to ask about a particularly tricky homework question. She had a really nice phrasing that made me kind of squeal a little bit inside which was like, 'This was a really different kind of problem that I really didn't know how to solve, but I'm glad that I got to practice it.' And I know that out of 400 students, one person saying that … wasn't maybe the biggest, but hopefully..."

Dana and Vicky, on the other hand, had more opportunities to interact directly with students during class time, which enabled them to gauge the extent to which students were taking up the opportunities to engage in SRL that they offered in that context.

Another constraining aspect related to time was having short academic terms. Across courses, the instructors perceived their 'buy- in' to bringing SRL innovations to their courses was constrained by not being able to see the incremental changes related to SRLSPs in such a short period (4 months). In our December CoI meeting, Laura said: "You build the ground but see minimal changes;" Peter added, "You might be doing a great thing, but it might not pay off until later beyond your class." Mike further contributed: "[Laura] is trying to get [students] to solve problems … 'What's the question asking you? What do you know already?' And they don't seem to be doing it this semester, but hopefully it's ingrained for them to use it later." In Decembers' CoI meeting, the instructors agreed that certainty about short-term/observable positive effects of teaching practices (SRL and others) would increase their buy-in for bringing innovations to their courses. They related buying into teaching innovations to their workload, mentioning that they did not have time to spare. Laura said: "If there were really effective interventions that you could do in your class, if there was like a magic bullet, and you just do it for the semester and it has this effect, everyone would do it" (December CoI meeting).

Laura and Dana perceived that their efforts to support SRL could be limited by a lack of university-wide, long-term continuity across undergraduate courses and throughout degree programs. In her exit interview, Laura explained: "I feel like the kind of thing that we were trying to teach [SRL] them

needs years to develop, and it needs consistency across their undergraduate degree." Similarly, Dana said: "They've been learning about SRL in my class, because we said it's context dependent … but then all they hear from other courses is that it is all content" (December CoI meeting). The instructors' perceived it was a problem when students engage in SRL in one out of many courses with no follow up in other courses throughout their degree. It made them wonder if their efforts really made a difference. However, in our last CoI meeting, the instructors agreed it was worth trying. Laura's words in the exit interview illustrate this idea:

> "[Supporting SRL] is like teaching a man to fish — it's meant to be something that will
>
> help them for the rest of their studies … I hope that they have a little voice in the back
>
> of their head saying: 'I should understand the concepts. I should think of ways to check
>
> my own work. I should not immediately check the solution.' I hope that little voice in
>
> the back of their head persists."

Evaluation Structures and Policies. In our final CoI meeting, the instructors agreed that it was easier to infuse SRL in their courses when they had some autonomy to design and control evaluation procedures (e.g., Dana in her advanced course, Laura's involvement in designing quizzes). Laura, Mike, and Peter recognized it was harder to build in supports for SRL in courses where assessment structures were imposed and prescribed (e.g., using the same midterm across sections); instructors were not involved in grading assignments (e.g., their teaching assistants graded quizzes and homework) or marked just one of the questions on the final exams across sections; and there was a policy of scaling grades. Mike expressed that not being involved in marking homework "puts a little bit of a curtain between you and students because you want to know how they do, so you can adjust your teaching during the semester" (exit interview). These instructors thought evaluation structures also constrained their efforts to support student learning processes because assessment and feedback were often outcome oriented. The instructors who taught multi-section courses noted that the imposed assessment structures limited their ability to observe whether and how their students were self-regulating in assignments and exams.

Some grading practices to ensure fairness and consistency across sections in multi-section courses (e.g., scaling term grades to match the final exam grade, distributed marking of the final exam, giving pass grades) were also perceived as constraining. In Decembers' CoI meeting Mike mentioned:

"[Departmental] policies on how many students should pass and how we should scale everything give students the impression that as long as they do the bare minimum, they're going to pass … it affects their learning … sometimes [students] just think if they do the homework, or if they just show up at the midterm, they're just going to pass".

In her exit interview, Laura explained the effect she perceived grading policies might have on her students: "[In exams or assignments] when we give [students] out of the box questions, they just see it as a hard problem. As the kind they can ignore because it's not worth much of their grade. They won't put effort in learning how to do this one problem … they think, I'm supposed to learn the mathematical content not the sort of lateral thinking skills." Laura and Mike suggested these university or unit wide policies invite students to engage at a surface level with learning activities in and outside of the classroom with the sole purpose of passing. They ultimately undermine student motivation to acquire expert-like skills and engage in SRL, which deflates instructors' interest in bringing SRL innovations into their classroom.

Technology. Technology was the fourth theme that emerged within systemic affordances and constraints for SRL supports. In our last CoI meeting, the instructors agreed that learning management systems and tools like clickers could both facilitate and limit their efforts at supporting student engagement in SRL. In relation to learning management systems, Peter, Mike, and Vicky perceived that these resources offered them a platform to extend SRL supports outside of the classroom (e.g., opportunities for practice). However, there was consensus amongst all instructors that students did not use these resources as often as instructors hoped (e.g., engaging in the process of solving a problem or offering [in]formative feedback to peers), which discouraged them from embedding a thoughtful SRL design in their learning management system platform. Vicky suggested that using technology tools like

clickers could make SRL related activities (e.g., reflection) more manageable and time effective in large classes. However, she acknowledged this tool was useful to begin a general dialogue and scan what was going on with students, but it did not necessarily engage them in thinking deeply about their learning.

Student

All of the instructors perceived that student attitudes and behaviours towards learning at university afforded or constrained their efforts at bringing SRL to their courses. For example, Peter perceived that when students think of undergraduate studies as the time to re-consider their learning process or habits, they are "open to consider themselves as learners, think about their learning, and change the way they learn" (Peter, December CoI meeting). This attitude to shifting their learning paradigm enables students to take up opportunities to engage with SRL supportive practices (e.g., reflection) and encourages instructors to embed those practices in their curriculum. However, all instructors expressed that their students' lack of awareness about needing to learn how to learn constrained their efforts at bringing SRL supports: "… when you talk about [how to learn] it's not for them because they feel they know how to do it …" (Dana, June CoI meeting) and "sometimes by the time they come to the realization [they could benefit from it], it's the end of term and it's a little too late" (Vicky, December CoI meeting). The instructors attributed this lack of awareness about needing to develop learning and study strategies to a lack of prior failure experiences, either because students were successful in high school or because the evaluation and grading policies protected students from failing.

Laura, Vicky, and Mike perceived that many students are resistant to changing their learning strategies despite instructor guidance and provision of opportunities to engage in SRL, which dampens instructors' motivation for bringing these supports to their courses. Laura felt that "this paradigm shift is just so difficult for them because of the past 13 years they just excelled and it's very hard to really get through to them that they can be creative" (June CoI Meeting). In relation to this resistance to shifting learning habits, Dana described how it takes a different form in advanced courses where students are expected to engage with content in a critical way, much like an expert: "It's really unsettling for [students] … the context is different and they're not [prepared for it]. They wonder, 'How do we prepare for an

exam when we don't know the answers [to problems on which experts are still working?']" Across all courses, the instructors identified transitioning to new learning contexts (e.g., from high school to first year university; from lower to upper-level courses; from college to university; from one learning culture to another) as key moments for students to make a paradigm shift in their approach to learning. They acknowledged adjusting to new learning contexts takes time for many students, and since many manage to move on through their degree without acquiring/using adaptive strategies, efforts to support SRL are often dismissed. Likewise, students that see university degrees as a steppingstone to get a job just focus on passing courses, which "kills their curiosity, their drive to learn to study" (Mike, June CoI meeting), and limits their openness to engaging in opportunities for SRL.

Another factor the instructors raised in the last CoI meeting as undermining their efforts for bringing SRL innovations to their courses was their students lacking the skills to transfer learning strategies to contexts outside of class. Mike's example illustrates this point: "I tried to get [students] participating and engaging and thinking as much as I could in the class. But once they're outside the class they're just, 'I don't know how to handle that one'" (November CoI Meeting). To greater or lesser extents, all instructors perceived they had minimal control over how long and how students engage with learning activities beyond the classroom; even if they infused SRL promoting practices in their teaching, they could not tell whether and how students regulated their learning outside of the classroom.

Instructor

Instructors' sense of competence about their knowledge and skill for supporting SRL, and their personal beliefs about teaching and learning emerged as factors that could afford and/or constrain their capacity or interest to infuse supports for SRL in their courses. Feeling knowledgeable about SRL and being open to learning and experimenting with SRL promoting practices influenced the instructors' positionality and level of comfort with incorporating these practices into their courses. In her exit interview, Dana shared that she "was very open with the students at the beginning. I said, 'This is not something I know about, I'm learning as we go and we're going to try things.' Then, I showed your slides [resources about SRL that were shared during the May CoI meeting], so they knew there was an expert

overseeing this and it wasn't just me trying to do random stuff." Similarly, Laura was keen on engaging

in a process of thinking about her teaching practice in a different way, saying: "I was not nearly as

ambitious as I was at the beginning of the summer, but I really wanted to experiment this semester"

(September CoI meeting). This attitude enabled these instructors to try different things throughout the

term to attain their SRL goals. On the other hand, Vicky found it challenging to find ways to support her

students due to the fact that she did not feel competent about practices to foster distributed learning. She

mentioned she still needed to learn how to best encourage her students to distribute learning over time, as

she observed her students continued to struggle with this skill throughout the duration of the term. During

our December CoI meeting, the instructors agreed that having collaborated with like-minded colleagues in

the study enhanced their knowledge about SRL in context and enabled them to feel more confident about

infusing SRL in their individual teaching practice. Likewise, they recognized that having institutional

support to engage in initiatives focused on teaching and learning enabled them to explore different

teaching practices and consider how to implement them in their courses.

Another theme that emerged for instructors as affording or constraining their efforts at bringing

SRL supports to their courses related to their beliefs about teaching and learning. Particularly, the

instructors perceived that beliefs about their responsibility for engaging students in learning how to learn

within their fields, along with believing whether they could make a difference in the learning trajectory of

their students, influenced their innovation efforts.

Regarding their responsibility for engaging students in learning how to learn within their fields,

all instructors believed that it was expected of them to teach students how to learn subject relevant

knowledge and skills. In our June CoI meeting, Vicky shared: "After seeing results on the midterm, my

director met with me to say, 'Hey how can we help these students, and what can you do?' I definitely felt

like there were expectations for me to change outcomes." They viewed supports for SRL as a way in

which they could meet those expectations. Peter's contribution in our May's CoI meeting manifests his

motivation for bringing innovations to his courses and expresses his sense of responsibility over teaching

beyond content: "I wanted to try to support students in learning how to learn. I think people separate their

math learning from their other learning if they are in different disciplines, so it's trying to bolster them to pivot on that one side."

All instructors also mentioned they felt responsible for empowering students to take control over their learning which fueled their interest in learning how to help students learn how to learn, how to teach them the skills to learn for themselves, and how to become life-long learners. For example, Vicky emphasized the importance of teaching students how to learn in her field (Computer Science): "If you don't know how to learn, you will not keep up with the field. You have to re-learn new technologies and new practices every year, so [teaching them how to learn] is a big thing for me" (May CoI meeting). Dana extended the responsibility to teaching how to learn within a discipline to advanced courses. She highlighted that, through her teaching, she sought to support students who, at the end of their degree, continue to struggle to think critically and flexibly about their subject matter, which is crucial in the workplace.

However, all instructors also questioned the limit of their responsibility for teaching students how to learn. For example, in our second CoI meeting, when talking about her plan for supporting SRL in her course, Laura added: "… I feel there is this awkward balance between holding someone's hand through SRL, like how much do I give them to teach them to not expect me to do things for them?" In our last CoI meeting, Dana and Vicky broached the ideas that instructors' perceptions of student expectations (e.g., tell me what to do because I'm paying my money) as well as the nature of their teaching appointments (e.g., limited contract or tenure stream) could influence instructors' sense of responsibility for teaching beyond content delivery and their commitment to bringing SRL innovations to their courses.

When joining the study, the instructors shared the belief that they could make a difference in the learning of their students. This belief became evident in our May's CoI meeting when they expressed their personal interest in bringing instructional innovations to their courses. Overall, the instructors mentioned their teaching went beyond content and they sought opportunities (like this study) to enhance their teaching practice in the service of student learning. However, some of the instructors also perceived their efficacy at influencing students' learning (using SRL supportive practices or not) was not necessarily

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under their control. Laura's anecdote in our December CoI meeting is a good example to illustrate this point:

"People who have been teaching [multi-section courses] for a very long time say no matter how good or bad the professor is, one professor cannot lower nor raise their class average. [If] they are competent, it doesn't matter how inspiring they are, the students pretty much get the same grades."

Extending this idea, she added that she felt she had less of an influence in maintaining the class culture in such big classes, which ultimately served as a barrier to her continued implementation of SRL practices. Laura commented: "The first couple of weeks I'm pretty good at influencing [the class culture], but it slips away ... If there's a few active people that participate then the whole class participates, but if there's no such people, there's little participation." Continuing the conversation, Mike added: "No matter what I do, or how good I try to do my job, still the final step is the student … without the student's influence it doesn't really go much further." These instructors believed students, as much, as they as instructors played an essential part in how teaching and learning unfolded in a given course.

Mike and Vicky believed they had planned and implemented supportive practices to make a difference in the learning of students; however, due to various reasons (e.g., focus on content, lack of time), they could not adjust their teaching practice as they would have liked. Nevertheless, they felt this realization was a good drive to tweak their practice going forward. Similarly, as Peter reflected on a course he had taught through an SRL lens, he said: "I know that I built a couple of supportive elements … I don't think I followed up on them properly, I recognized that by looking back through what actually happened … really [helped me think] how I can strengthen it" (June CoI Meeting). These instructors perceived that having more time for planning and reflecting about their teaching practice would be affording to bringing SRL supports to their courses.

Summary

Generally, the instructors perceived their students engaged productively with SRL opportunities, but they recognized that both the way they implemented the SRLSPs in their courses and student

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openness to these supports determined students' uptake. Across courses, the instructors perceived that integrating SRLSPs (e.g., instructional supports) in regularly occurring activities seemed to be more effective than adding one-off SRL supportive activities (e.g., reflection). Moreover, they concluded that consistent and timely supports were essential for students to learn well and apply SRL knowledge and skills. Summarizing across courses, the instructors who taught during the study observed positive changes in participation and performance, as evidenced through richer contributions, thinking, and reasoning on the part of students. Importantly, the four instructors I observed, were cautious in attributing the differences they observed to the SRLSPs alone.

The students who spoke with me about their personal experience with SRLSPs in their courses recognized when and how the supports were helpful (or not) for them to engage in SRL. Some of them noted instructional supports (e.g., modeling and guided problem solving), the learning atmosphere, and knowledge co-construction supported them to approach learning intentionally and strategically. Likewise, some of them perceived SRLSPs boosted their confidence and helped them learn about themselves as learners. However, other students did not find some SRL supports (e.g., reflection, choice) valuable or necessary, and some of them experienced these as overwhelming. Like the instructors, the students suggested that the implementation of SRLSPs made a difference in how they took up these opportunities.

The instructors perceived that interrelated systemic (i.e., course structure/culture, time, evaluation structures and policies and technology), student (i.e., attitude/awareness about shifting learning strategies), and instructor (i.e., feelings of competence about SRL, beliefs about teaching and learning) factors both afforded and challenged their efforts at bringing supports for SRL to their courses. Crucially, the positive impact instructors observed SRL supports had on student learning, participation, and performance counterbalanced the challenges they faced to infusing SRL supports in their courses. Their sentiment about teaching for SRL in undergraduate courses going forward is best illustrated with Laura's words: "I'm believing more and more that teaching how to learn is necessary for me to do my job. If not me, then who?" (May CoI meeting).

Chapter Seven: Productive, Validating and Transformative Research Process

In this chapter, I address my last research question: What roles did a Community of Inquiry (CoI), as a collaborative structure, and individual inquiry, as a process, play in helping this group of instructors translate and mobilize SRL research in their practice? First, I describe organizational and climate qualities of the CoI and features of the inquiry processes instructors identified as facilitating their engagement in learning about SRL and advancing their teaching and professional practices. Next, I focus on the value of pairing collaborative with individual inquiry to help instructors to contextualize SRL supports. Finally, I share evidence of changes in the instructors' teaching practices that are attributable to their engagement in these processes—evidence found in the instructors' CoI reflection templates, meeting notes and transcripts, as well as in their exit interviews.

CoI and Inquiry Qualities

"I think that the actual process [group format, collaborative and individual inquiry] was really valuable, and speaking to the other participants, they also did." (Peter, exit interview)

CoI Qualities

Instructors pointed to both organizational and climate qualities when talking about how the CoI, as a collaborative structure, enabled and sustained their engagement in inquiry processes and helped them learn about SRL and SRLSPs.

All of the instructors perceived the time commitment (i.e., five meetings of 90 minutes each) was manageable and appreciated having an external organizer (me) who brought the group together on a regular basis: "you made us make the appointments. I don't know without that … what would happen" (Vicky, exit interview). In his exit interview, Peter validated this point from his professional development stance: "There would be interest for faculty, having seen how [instructors in this group] responded. I think it's having that time, it's not a massive time commitment, but it's a consistent commitment with somebody who is coordinating and paying attention to it." They identified the predictable meeting structure, recurring activities, and regular space as characteristics that eased their comfort at sharing professional and personal experiences, beliefs, and insights about teaching for SRL with the group. Peter's words in

the exit interview illustrate this idea: "… [meeting as a group] made the whole thing an experience where people came, focused on the process [sharing and building knowledge together], and then they went back to other things … I really valued the process and that's something I'll take with me."

All the instructors perceived the atmosphere and climate of the CoI as a positive, safe, and nurturing space where they were positioned as both expert practitioners and learners in the process of designing and implementing SRLSPs in their courses (e.g., adapting existing tasks, creating new activities, revisiting their teaching practice through an SRL lens). In their exit interviews and at the beginning/end of our CoI meetings, the instructors commented that the food I brought to each meeting created a positive climate and helped them bond as a group. They particularly valued the agency and reciprocity built into the process. For example, in the exit interview Peter said:

> "I really appreciated how you [designed our work together], because obviously you had
>
> your questions and [a process], but it was intended to be an exploration for the
>
> participants as well, so we were also driving it in a sense, at least for the individual
>
> inquiry."

They appreciated the experience of having a community as a forum for discussion with support from an "expert" and like-minded colleagues. Vicky's comment in her exit interview illustrates this point: "It was just really nice to talk with other instructors. We don't take time to do that—to talk with other instructors about what they're trying, what they're doing, what's working, what's not working." The four instructors that implemented SRL supports in their courses underscored that belonging to the CoI added to feeling safe to "play" with SRLSPs in their courses because they "knew they were not alone" (Dana, December CoI meeting). In the exit interview, all instructors indicated they would likely engage in another group inquiry to explore topics of interest if they have someone who is knowledgeable about the topic that can guide the process and there is a clearly defined structure in place.

Inquiry Qualities

The instructors' comments in CoI templates and in exit interviews surfaced qualities of the processes of inquiry (individual and collaborative) that made a difference in their experience of bringing

SRL supports to their courses. Laura and Dana emphasized their engagement in inquiry processes

fostered productivity, and to greater or lesser extents, all instructors highlighted that it was validating.

Fostering Productivity. Laura and Dana mentioned in the exit interview that engaging in

individual and collaborative inquiry simultaneously helped them remain accountable and keep the focus

on achieving their individual teaching plans for the semester. As Laura expressed in the exit interview:

"[You] come off the summer and have all these great ideas kicking around in your head

and you sort of try a thing here and a thing there. And then as the semester wears on,

you pare it down and then you kind of forget about it, at least I do … Even though

[collaborative inquiry meetings happened] only like once a month or so, having that

reminder and accountability really helped me stay focused."

Laura and Dana acknowledged that innovative teaching plans often are not implemented. Dana

explained: "Once you put it in writing, you say, 'This is not going to work. I'm not going to try'" (exit

interview). It seems the added opportunity that the collaborative inquiry offered for learning and

discussing SRL, as well as individually enacting, reflecting, and adapting their written plans over the

course of the term in an iterative fashion, proved helpful in mobilizing knowledge to action in their

classroom.

These instructors expressed that sharing with colleagues the plans and actions emerging from

their individual inquiry and/or articulating their perceptions about supporting SRL in the CoI was

instrumental for refining their actions and shaping their thoughts and beliefs about their SRL-focused

teaching. For example, Dana mentioned in the exit interview: "Sometimes I would be a bit hesitant … and

being able to talk about it [in the CoI] gave a structure to things that I had tried or I might try [in my

personal inquiry]." On a similar note, Laura appreciated the opportunity to share with the CoI how she

felt about fostering SRL: "It was nice to have the opportunity to crystallize my thoughts on a student who

said something that had been bugging me" (November CoI checkout). Laura mentioned that talking about

her personal inquiry and hearing from others in the CoI "[provoked her] into a slightly different style of

problem solving on the [whiteboard] where [she] made a lot of things more explicit than [she] otherwise

had, which [she thought she] wouldn't have come to if [she] hadn't been part of the group" (exit interview). It seems that engaging in collaborative and individual inquiry helped these instructors remain accountable and focused on their efforts to support SRL in their courses.

Fostering a Sense of Validation. Throughout the study, all instructors perceived their teaching and/or professional practice were validated through their engagement in collaborative and individual inquiry processes. They identified the personalized and situated coaching that I provided (both in the CoI and as part of their individual inquiry) and the interaction with other members in the group as main sources of validation. Dana said: "The kind of information that you gave us was super helpful … it validated what I was doing. I was doing something and maybe it didn't work very well, but it wasn't something that I just made up" (exit interview). The four instructors who taught during the study expressed that the debrief conversations after classroom observations made them feel particularly reassured and encouraged to continue adapting SRL theory to their practice.

Those instructors that implemented SRLSPs in their courses commented in the exit interviews that it was validating to know that they had a group (i.e., the CoI) to come back to and share how things were going for them, and to support/learn from one another in their successes, failures, or missteps at contextualizing SRLSPs. Hearing how others had brought SRL supports into their classrooms, or were thinking about it, was perceived as validating. Particularly knowing that others had done something similar to what they had done or had encountered a similar challenge in their SRL-focused teaching. For example, in the third CoI meeting after Mike shared how he was scaffolding learning in his course, Vicky sought clarification and added: "I have the same issue … [students] see a problem and think, 'I need to write this big program!' … I need them to find the steps ... [modeling and scaffolding can] move them from novice to expert thinking." In subsequent meetings Vicky and Mike expressed interest in borrowing from each other's experience about scaffolding student work in class through worksheets, modeling, and demonstrating. In the exit interview, Peter mentioned that having experienced the process of collaborative inquiry had validated his thoughts and ideas in relation to innovating in his role as educational developer.

Some instructors commented that interactions in the CoI helped them realize they had similar

interests, challenges, experiences, and questions about contextualizing SRL supports in their course. For example, after a think-pair-share activity in our December CoI meeting, Laura mentioned: "I felt validated in my observation [attained through her personal inquiry] that it's tough to notice change after one semester" (CoI checkout). Moreover, having similar experiences as they navigated through their individual inquiry helped them feel reassured about their process; to this end, Vicky mentioned, "it was really interesting to see this common thread between all of us … we really wanted students to establish a problem-solving process for themselves … and we had somewhat different ways of teaching the process" (exit interview). Regarding the way in which her inquiry unfolded, Vicky wrote "it was great to hear others were scaling back their goals of introducing SRL" (November CoI checkout). All instructors expressed in their exit interviews that this perceived sense of shared experience encouraged them to further reflect, find ways to collaborate with CoI members beyond our group meetings, or seek out like-minded colleagues within their disciplines to further explore teaching and learning through an SRL lens.

Pairing Collaborative with Individual Inquiry: Co-Constructing Meaning

In my roles as observer, facilitator, and member of the CoI, I noted three rich forms of interactive meaning-making that occurred in the group and enabled genuine knowledge exchanges: inspiring dialogue, questions, and tasks. These exchanges fed the instructors' individual inquiry processes and facilitated a shared understanding about contextualizing SRL supports in undergraduate courses.

Inspiring Dialogue

During CoI meetings and through data analysis, I observed that inspiring conversations in which the instructors shared their teaching experience about supporting SRL, their personal experiences as self-regulated learners, and specific resources, grounded the co-construction of meaning in the CoI. A clear example of such inspiring dialogue occurred during our November CoI meeting. In this meeting, we spent some time talking about in class supports for students whose emotions overwhelm them during testing situations. Mike and Dana described how some of these students often just write what they know, even if it is unrelated to the question, or they cannot produce anything. The following is an excerpt from the dialogue that followed:

*Pete*r: "I wonder [if working] with other students [could help]. [One student] can stop the other from going too far off in one direction or to help them get unstuck ... Two people [solving the problems together]. One of them thinks aloud, say what they're doing, with the other person supporting them so that they can [adjust their thinking] … I'm thinking how to give them opportunities to practice doing this."

Laura: "I wonder if you can [invite two students to the front of the class], identify [one] as the 'talker' and the [other one] as the 'writer' … the talker has to clearly enunciate how they're planning on solving the problem for the other person to write it. The talker practices enunciating the steps and the writer sees how they approached the problem."

Peter: "It's like the pair programming concept .... one person who is doing it and one person who is monitoring. Then they swap [roles]. My understanding is that people get better at programming on their own as a result of doing this or is it just that as a pair they are much more efficient. I can't remember. Maybe both."

Vicky: "What I do in class is choose a student's work, [work] that's almost there and has a couple of common errors … I go through it [with the whole class]. [Students] have a chance to [first] try it on their own and then see someone else's solution. They see everyone is not perfect [and after sharing] they can correct the general errors. It is a way to do what you're talking about without taking as much time."

Mike: "I've tried to make them lead me to the answer and I correct them along the way."

Peter: "It's still you driving it, it's different from students presenting their proof."

Systematic analysis of meeting notes showed this type of dialogic inspiration occurred in every meeting which then resulted in new questions, ideas, and possible teaching actions. These excerpts, along with the instructors' comments during meetings and interviews, suggested how co-constructing knowledge in the CoI added value to the instructors' individual inquiry processes. For example, in the exit interview, Vicky mentioned that the array of possibilities to support SRL in her courses broadened by

learning how Laura had shared educational research with her students, or Dana had woven SRL supports throughout her course.

On some occasions, knowledge co-construction seemed to emerge from the instructors' insights about their own learning experiences, as seen through an SRL lens. For example, in our September CoI meeting during a conversation about offering students opportunities to learn from errors, Dana said: "I failed math pretty much all the way through high school and part of the reason was that no one ever told me that it's normal that you may not know something right away." Instructors re-positioned themselves as undergraduate learners, which enabled them to value the SRL framework from their students' points of view. These insights sparked rich conversations and inspired them to share resources they found personally useful to translate theory into practice. For example, following Dana's comment above about her personal experience with math, the following conversation occurred:

> *Vicky*: "There is a study in which people had to make clay vases. One group was told: 'You need to make the most perfect clay vase and you get one chance.' The other group was told: 'You are going to make as many as you can.' The group that was told to make just one, kind of froze. The other group prototyped and prototyped and came up with … better results. This rapid prototyping got them to change and fix the errors."

> *Mike*: "Makes sense, you try something, you see the error. There are lots of things that you may not foresee …"

> *Vicky*: "Yeah, it's like [Mike's] problem with his students [who start writing right away without planning], like, 'try to stop, that path isn't going to work, so try another one.'"

> *Laura*: "It's also like the expert mathematician finding the answers [taking time to analyze the problems] … I really like that vase story, it's so suitable."

These resources served as inspirational examples for instructors to translate theory into practice but also as tools to share with students and colleagues alike. For example, after this meeting, Peter approached Laura and said: "I may use those [images the journal article you shared] because they are so

evocative, they're so easy to describe and they make sense. Using them as a tool makes the process easy to visualize."

Questioning

As each instructor shared their actions and reflections in CoI meetings, others in the group would stretch their thinking, and that of the group, through questions. These questions resulted in amicable, productive, and enriching conversations. For example, in the third CoI meeting Peter shared a check-in reflection activity in which he asked his students to briefly write how they had studied for a quiz (e.g., which resources they used and how) and whether they felt prepared to take it. This anecdote inspired Laura to pose a question to the group: "Do you think that just the act of asking students to write down how they studied has an impact on how they study? Just the act of thinking critically about what they were doing would encourage them to do more?"

Tasks

A guiding question focused our conversation in every CoI meeting; in the first and last meetings, however, we engaged in tasks that sought to foster the co-construction of meaning. For example, in our December meeting, we engaged in a think-pair-share activity with the purpose of generating a co-constructed understanding of contextualizing SRL supports. In this activity, the instructors worked in small groups to reflect on contextual affordances and barriers to bringing supports for SRL to their courses—what worked and didn't work? Figure 7.2 depicts small group notes that we then fleshed out in our group discussion.

An analysis of the meeting notes showed that bringing together the instructors' experience of teaching for SRL in undergraduate courses across academic disciplines within the same institution was enlightening for all members of the CoI. Through this think-pair-share experience we negotiated and solidified understandings that we had been co-constructing throughout our work as a group. This summarizing activity enabled instructors to appreciate both their and others' situated SRL-focused teaching efforts and invited them to continue their personal inquiry into the scholarship of teaching and learning. Vicky's words illustrate this idea:

"Today's meeting was great as it forced us to reflect on all of the things that we as a group have tried throughout the term. It highlighted the similarities in the approaches that we have attempted even though the course content was so different, which gave me some ideas for addressing some of the limitations that I encountered both from what others had tried and even the brainstorming that surrounded our reflections" (December CoI reflection template).

Figure 7.2

Think-Pair-Share Activity Notes December CoI Meeting
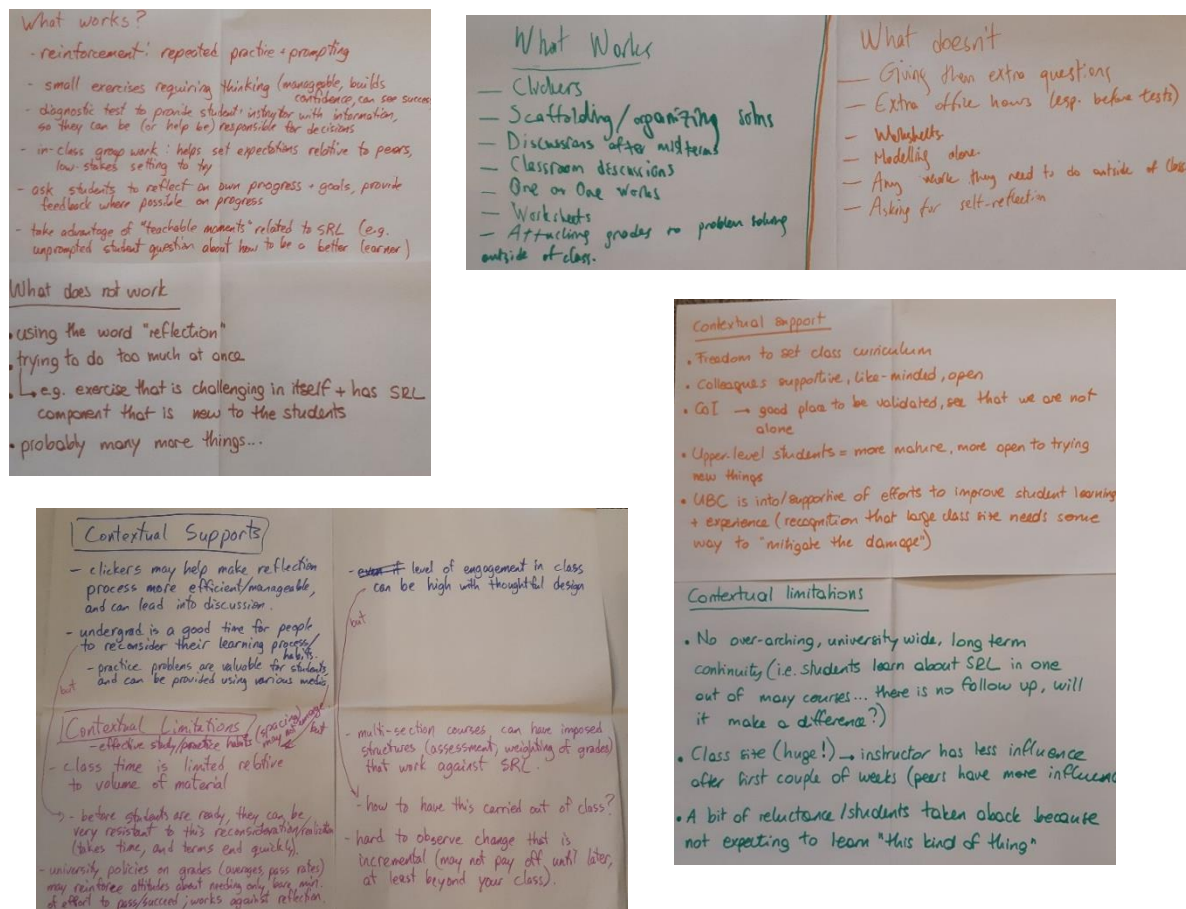
Changes in Teaching Practice

Throughout the study, the instructors recorded what they were learning about teaching and learning, generally, and about supporting SRL, specifically, in CoI documents. However, it was in the final interview and subsequent member checks where they reflected in depth about how their participation

in the inquiry processes had been instrumental in shifting some aspects of their practice. Evidence showed that to greater or lesser extents, instructors recognized changes in their teaching practice in three areas: process; perspectives and focus; and perceived competence.

Process

A pattern I observed across the instructors who were teaching during the study was that they took an inquiry approach to teaching. In their exit interviews, these instructors mentioned their approach to teaching and attentiveness to what was going on with their students were more deliberate compared to a more intuitive approach they took whilst teaching previous courses. Taking a more intentional approach to teaching involved shifts in planning and/or monitoring routines that they sustained over the term and, for some instructors, went beyond their focal courses.

In terms of planning, Laura, Dana, Vicky, and Mike reported having invested more time preparing for their courses and individual classes within their course when they began looking at class materials (e.g., syllabus, tasks/activities, use of class time) through an SRL lens. Dana's reflection after June's CoI meeting illustrates this idea:

> "I went back and looked at my syllabus and all the information I gave to the students
>
> and I found it was almost like I wanted to have SRL in there but I didn't know about it.
>
> So it came out really weird. I told them that the goal for them was to become
>
> independent learners, but then, when I explained it in detail it went like: 'You should
>
> know where to find the information, how to deal with the information,' as opposed to
>
> saying, 'You should know when you need more information,' like focus more on the
>
> process."

Likewise, Vicky recalled having spent more time thinking about how to engage students in reflection, indicating that: "[I spent more time] than I would normally do because, you know, when preparing for lectures you're thinking about content, but I felt like, throughout the course, at certain points, I was thinking a lot about getting them to reflect" (exit interview). Spending more time preparing for their course or each class and focusing both on the "how" of learning and on the needs of students

became a routine for these instructors. For example, in the exit interview, Mike said: "This semester I was trying to be a bit more careful about what extra things I could add. How to lay out the proofs … figure out where to put the steps because I was trying to do more scaffolding."

Dana also reported engaging more regularly in reflecting on her teaching, which she characterized as valuable, productive, and enriching. Here are Dana's words in the exit interview:

"After each class, I would write some notes in my book … even small things that happened, or I should do differently, or change for next year. I think [making these notes] was something I always knew would be a good thing to do … I did it before, if something really particular happened. I made notes because it would be useful for the future ... [This term] I thought of what happened in class and just the act of thinking reminded me of more, you know, if you just ask me what happened today, [I'd say], 'Well, nothing, really,' but once I started thinking, [I'd realize], 'Well actually it was this, there was that, maybe I could have done something differently or this would be…' That's the other thing that happened, sometimes I thought this would have been a good place where I could have … linked to SRL, or this didn't work very well, but maybe if I'd given some supports."

Even though, for the purposes of the study, the instructors were only invited to engage in inquiry about their teaching practice in the focal course where they were contextualizing SRL supports, Laura, Mike, and Dana observed themselves taking this reflective approach in other courses. For instance, Dana mentioned in her exit interview:

"… I'm teaching the first year [Biology] class too, and I found … even without really paying attention to it … some of the SRL was kind of creeping in, especially the understanding of the task. For first year students, I think it's much more of an issue. A number of times when we would do worksheets in class, I'd say, 'Please just check with your neighbor that you know what you're doing and it's the same thing, that you're doing the same thing'."

All instructors commented about having had conversations with colleagues about teaching and learning where they shared their experience of supporting SRL and thought critically about their role as instructors. Likewise, they found themselves more attentive to their colleague's approaches: "I started hearing people's approaches more, not just [within the CoI] but outside. I heard someone talk about the community of homework… students keep writing until they get it right … and thought: 'what a nice [approach]'" (Mike, exit interview).

Perspectives and Focus

Evidence showed that each instructor perceived their engagement in inquiry about SRL-focused teaching translated to enriched perspectives not only about their role as instructors but also about their students. All instructors discussed their intentions to focus more on progress and process rather than on content delivery and outcomes. These shifts in perspectives and focus brewed during the instructors' participation in the study and were expressed in CoI documents and exit interviews. Nevertheless, it is relevant to consider that the instructors also built from their teaching expertise, background knowledge, and experience with student-centred teaching.

Enriched Perspectives About Instructors' Role. A shared understanding among the instructors in the CoI was that teaching and learning is a joint effort between teachers and students; as instructors, they played only a small part in the learning experience of a student over the course of their degree. Nevertheless, all of them deemed this small part to be hugely relevant. Particularly, they described how their role as instructors was linked to engaging students in productive and agentic learning from early stages in their degrees and wished for more consistency across programs in doing so. Peter's words are useful to illustrate this idea:

> "We know … a lot of [first year] students that struggle. How do we support them? How
> do we think about it more broadly? It's not just about your class, it's about what's
> happening with the students … it's overwhelming on your own, you can't with 200
> students, but maybe as a team we can do something about it, so it's partly [instructors]
> thinking about it more as a team effort while teaching or educating" (exit interview).

Another aspect that each instructor surfaced in terms of their role as instructors was the need to question the prevalent mandate of foregrounding content delivery over teaching life-long learning skills. Dana and Vicky talked about this idea in their exit interviews:

"One of the big things that SRL did to me, is that it helped me put into context all the content that we teach … there's no reason to rush and push content because the more the better. There are more important things, like this student who said: 'Oh! Now I know how to prepare for class and how things work for me.' That's so much more usable and transferable. If you had to put the value on it, it's time well spent if students use time in class figuring that out versus time spent answering questions." (Dana)

"… Give [students] the opportunity to decide how they're going to learn. I think that's the goal. You want them to be curious and learn on their own and become lifelong learners. It's not about learning just one course, lesson, or the material. It's all about knowing how to learn. That's what I see my job to be, not to teach someone content." (Vicky)

Notwithstanding, Vicky, Laura, and Mike also highlighted that their influence and efforts at supporting students were limited by the reality that "until [students] are willing to learn, to really put in some effort and learn, you can spoon feed them but that's not going to do it, you're not going to get it" (Vicky, exit interview). One way or another, all instructors acknowledged their role was related to guiding for independence rather than "hand-holding or nagging" their students to do their work; as Peter put it: "there's things that an instructor can do and there's things that an instructor basically just can't. There are certain kinds of supports [e.g., for mental health concerns or learning disabilities] that are really more appropriately handled outside of the classroom" (exit interview). All instructors recognized that adapting their teaching practice was something they could do to support students. Laura said: "I might just choose one hill to plant my flag on" (November CoI meeting), and then expanded on this point in the exit interview:

" I think what I was missing was something that is fundamental with teaching, which is just saying something doesn't mean that the students internalize it, and if what we're

trying to work on is really skill building, you have to sort of, you can't just shot gun a

bunch of information, you have to go deep … it might be better to just really hit one

thing, especially since, like we were talking about with Dana, there's not a lot of

continuity across their studies."

While each instructor adapted their teaching in different ways and to different extents during the

study, all of them identified areas of their teaching where they could continue building SRL supports.

Enriched Perspectives About Students. Evidence showed that the instructors broadened their

perspectives about their students and what they brought to the learning context. These enriched

perspectives resulted from the instructors' involvement in inquiry (e.g., How do I make a difference in

students' learning? How am I making a difference?) and their engagement with some research activities

(i.e., completing the background questionnaire and participating in CoI meetings). A systematic analysis

of the instructors' reflections revealed that they had increased their awareness of their students'

demographics (e.g., certain courses tend to enrol more female than male students), background (e.g.,

many second-year students have transferred from another institution, rather than entering directly from

high school), and/or needs (e.g., students who are registered with student services and require

accommodations). Importantly, these reflections also showed that being more aware about their students

shaped the way instructors thought about their teaching practice during the term and/or going forward.

Throughout the process of inquiry, Laura's, Mike's and Dana's awareness about the influence of

students' mental health on performance (i.e., anxiety, stress) and class participation (i.e., fear of speaking

up) also broadened. For example, Laura and Dana found themselves having one-on-one conversations

with students whose anxiety derailed their performance on midterms or class activities; these

conversations led them to wonder how they could support students through their teaching. They reported

having more engaging conversations with students than they had in previous courses as well as making

more meaningful effort to respond to that input. For instance, Dana said: "[Conversations with students]

are much more two way … I've had other nice cohorts, but this one was particularly good. I wonder if it's

connected to the fact that I started seeing the students' work differently and being less directive" (exit interview).

By being more attentive to what was going on with their students, some instructors (e.g., Laura, Dana, Vicky) realized that almost all students look like they want to learn but some do not believe they can produce 'A' type work, while others "need time to act on their 'resolutions' and time to fail to act on them and this does not mean they are not trying, it just takes them time to act successfully" (Dana, November CoI reflection template). This realization made instructors like Dana shift their teaching to focus on progress and the individuality students bring to her courses, rather than on general outcomes and average performance. Peter, Laura, and Mike thought this focus shift was challenging, yet not impossible to attain, in large introductory courses. Regardless of their class size, all instructors wondered how to better evaluate student learning to foster authentic and transferable learning and skills rather than rote memorization. In the exit interview, Dana shared:

> "I'm kind of conflicted, on the one hand there is an idea that you should just assess the work kind of separate from the students, but I find more and more that I can't really because different students come in with different skills. And so when one student who has been struggling does something and it's quite good, the feedback I give would be different, or I'd emphasize different things. But if it's a really good student who does the same kind of work, for them it's just mediocre. I feel that I'm really starting to see their work differently, more in terms of progress."

Seeing their teaching through the perspective of their students allowed instructors like Vicky, Laura, and Dana to reflect on how the expectations they put on their students can actually jeopardize student learning. Through this reflection process, they realized that, ultimately, their job as instructors is to meet students where they are at and guide them to get where they need them to be. For example, Vicky mentioned that she would love for her students to have a plan set before they go ahead with programming, but then added: "I feel like they aren't expert enough to have it all in their head … scaffolding and modeling will get them there" (November CoI meeting).

Perceived Competence

All instructors reported having greater understanding about teaching and learning in general, in addition to supporting SRL in particular. An analysis of their records of learning throughout the study suggests that all instructors ended the study feeling more knowledgeable about SRL theory in context and/or about themselves as instructors. The analyses also showed they continued to have questions about how to mobilize SRL theory into their teaching practice. Vicky's words in the exit interview illustrate this idea: "I feel my teaching practice still needs to change to support [student engagement in SRL] … it needs to be more consistent … I still think I don't have it right." The instructors' involvement in the CoI and process of inquiry refined the knowledge they already had and offered a framework from which to [re]view their practice. While some instructors perceived great gains to their teaching practice, some linked gains to a narrow set of teaching practices. Nevertheless, they all deemed the small and big changes to their practice would be sustainable.

Enhanced Knowledge. To greater or lesser extents, all instructors enhanced their knowledge or reframed former understandings about teaching and learning in context by looking at their teaching practice through an SRL lens and participating in collaborative inquiry. Even though the instructors' knowledge about concepts related to SRL varied at the outset of the study, by the end, all of them reported having gained specific terminology and a more cohesive view of the theory to support their teaching practice. For example, Mike said: "I have more ideas and I'm thinking more critically about teaching … and found other angles to approach teaching students to learn how to learn" (exit interview). All instructors described how this increased familiarity with SRL as a teaching and learning framework empowered them to reframe their teaching practice and bring sustainable innovations to their courses. For example, Peter mentioned in the exit interview how his involvement in the study was a chance to deliberately organize his ideas and goals about teaching and learning through an SRL lens. He mentioned: "Many [SRL] ideas involved things that I kind of knew about … what I thought through isn't even that specific to the one course, I can see whatever I teach next, there is potential to use these ideas."

Re-Valuing Teaching Practices. All instructors reported a new or renewed appreciation for

teaching practices as supportive of SRL, which sprung either from hearing about them from others, or from their own experience at implementing them. For Laura and Dana, re-valuing teaching practices as supportive of SRL meant a direct and meaningful mobilization of SRL theory to practice. In the exit interview, Laura described shifts to her teaching practice as the academic term unfolded:

"In tandem with making everything more explicit when I was on the whiteboard, I also changed how I asked leading questions in person and on my [discussion board] … instead of just asking questions to get [students] to an answer, I also asked questions that had more to do with SRL like: 'What's something you could think of to check your answer?' I think it's given me a better idea of the kinds of conversations that I can have with students, and those have definitely changed."

Vicky and Mike enriched their knowledge about teaching for SRL which made them think differently and expand their perspectives about some teaching practices. For example, Mike initially said he was skeptical about using worksheets in large classes but reported learning from Vicky and Laura that, depending on how these are implemented, worksheets can be an SRL supportive vehicle (e.g., increases participation, provides a sense of control over challenge) regardless of class size. In relation to this realization, he said: "I'm kind of giving it a little bit more value. I think it may actually be a good asset in teaching" (exit interview). Inspired by Dana's and Vicky's use of peer review to inform student learning, Mike mentioned: "It can be pretty useful for students to see other students' work" (exit interview). Like Mike, some of the other instructors also reported having consolidated their thinking about the value and/or implementation of different SRLSPs, which they planned on embedding in future course offerings. For example, Vicky described in the exit interview how seeing Dana "trying to weave [SRL supports] through the course," inspired her to think how to do it in her courses. She added:

"The big take away would be the importance of providing students with not just things to practice or things to allow them to learn on their own in class, but also the importance of … making scaffolding a little more explicit, giving [students] some structure for when they practice on their own, but also giving them choice. That's the one thing that

we don't have in this course. Any time you can give them the choice in what they do, can also encourage their self-regulated learning because it makes them a little more interested" (exit interview).

Some instructors changed their perspectives about teaching based on their personal experience implementing SRLSPs in their courses, the value they attached to those practices, and their focus on making a difference in the learning experience of their students. For instance, Dana said in the exit interview:

"There are things that I would definitely change. I learned so much from the students' perspective [through reflection assignments] … one thing is I don't want to do midterms anymore. Most [students] are talking about it and it doesn't seem like they are useful for them to learn … I have a million other ways to assess them … I like it when assessments are a learning experience … Before I thought, 'Oh it's a learning experience in the sense that they're going to be studying, so they learn, but I can make them study in a different way so that what they produce is actually useful and the process is useful …' A couple of students came in and said, 'How do I learn to write faster, because often I know what I want to say but I don't have time to just write in the midterm.' So, I thought, 'This is really bad because I shouldn't be grading on the speed…' I was thinking, for example, I could make them do research, create a Wikipedia entry for a concept. You know it's not too out of reach and they could work in teams or by themselves. It's something and then it's there. They've done it and it's useful."

Sustainable Teaching for SRL. All of the instructors, regardless of class size or discipline, acknowledged that supporting SRL in their courses was challenging. For example, Laura described how "it really takes a focused effort for a long amount of time" (exit interview), while Mike indicated that "it's tough when the students don't do their parts" (December CoI meeting). However, they felt that having an enhanced understanding of SRL in context was empowering enough to sustain the aforementioned

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changes to their teaching practice. Nevertheless, all instructors were cognizant that it was up to students to take up the opportunities they presented. In the exit interview, all of the instructors expressed their intentions to continue exploring ways to implement SRL in future course offerings. They were committed to sustaining the intentional, planned, and reflexive approach to teaching they adopted through the study. Table 7.1 presents intended next steps for this group of instructors in their journey of mobilizing SRL to their teaching and professional practice.

Table 7.1

Intended Next Steps in Supporting SRL in Undergraduate Courses

Instructor	Next Steps in SRL-Focused Teaching
Laura	Goal: Continue fostering student metacognitive development and collaborate with other instructors with similar goals.
	"I will probably persist and continue pushing this problem solving, critical thinking, metacognition in this sustainable way where it's woven throughout everything instead of using demos and other things separate from class, that is a bit artificial and contrived" (exit interview).
Dana	Goal: Continue incorporating SRL supports in this and other courses.
	"Find some way to assess/monitor/document student progress in terms of their ability to use evidence to change their 'ineffective' learning approaches … Next year in this class I will have several specific SRL learning goals; will substitute at least one (maybe both) midterm with real, collaborative, creative projects" (December CoI meeting reflection template).
Mike	Goal: Transfer, adapt, and extend the scaffolding practice to other courses.
	"I'll try to get students to work outside of class time. I'm thinking about the idea of cumulative pass-fail homework where students keep writing some questions until they can pass them. Hopefully put in some peer review platform" (December CoI meeting reflection template).
Vicky	Goal: Augment in-class SRL supports and extend scaffolding through technology.
	"Think about how to integrate reflection for students into my classes for next term. Next time I teach the course, I will work to interweave solution modeling with worksheet-based exercises to allow students to get a chance to experience both seeing a worked example and working through the cycle of strategic action steps" (December CoI meeting reflection template). In addition, Vicky designed a scaffolding tool to engage students in distributed learning in and out of class which she planned to launch in the next offering of the course.
Peter	Goal: Apply the SRL framework to future teaching opportunities and create a community of inquiry to explore other topics.
	"Use the cycle of strategic action in faculty development; reach out to other CoI members to discuss ideas; approach instructors from 100-level courses with ideas from this work and see if that can somehow be integrated" (December CoI meeting reflection template).

In communications with some of the instructors since the end of my data collection (including member checks), I learned how Dana, Vicky, and Mike continued to implement SRLSPs in their teaching (in both in-person and online settings) and how their efforts were making a difference in student learning. For example, in a personal communication (October 2020), Mike shared that he was teaching the proofs course again and was achieving positive results using the peer-grading and in-class worksheets he had planned to implement at the end of the study. Dana shared examples of student behaviours and attitudes that she interpreted as students self-regulating in her courses and linked these behaviours to the SRL supports she had continued to embed in her teaching. In a personal communication (September 2020), she said:

> "You should see how so many students, especially my first-year students, take elements of SRL to heart and use them to self-diagnose issues with their study methods or test-taking strategies. They come to my office hours saying, for example, that they are good at persisting when tasks are difficult but have a hard time 'responding flexibly' in the course and need suggestions on how to change their study strategy. Or they recognize that they did not take the time to understand the task. Last year, a couple of students wrote 'Stop. What is the task?' in capital letters on their final exam 'cheat sheet'. I could go on and on about how I see students managing their learning efforts."

On different occasions, each instructor has contacted me or recommended their colleagues to reach out for guidance on research/resources on SRL related topics that they were interested in learning more about. This is indicative of the instructors' sustained efforts to infuse SRL supports in their teaching practice as well as of their involvement in conversations with colleagues about teaching for SRL in university courses.

Summary

The combination of a collaborative structure and self-study inquiry processes to intentionally design, implement, and adapt SRLSPs in the context of teaching a course in real time enabled this group of instructors to build SRL principles in their teaching practice. The instructors perceived that

organizational and climate aspects of the CoI facilitated their engagement in inquiry processes to advance their practice. Likewise, they perceived that both the collaborative and individual inquiry processes were productive and validating to mobilize SRL theory into their practice. Rich forms of meaning-making in our group interactions (i.e., dialogue, questions, activities) enabled the CoI members to share their academic and practical expertise while learning with and from one another, which then informed their personal SRL-focused teaching.

Evidence suggested that, although displayed in different ways and to different degrees, these instructors' involvement in the inquiry processes enhanced their knowledge about SRL as a situated teaching and learning framework and enriched their practice and perspectives about their role in supporting students' learning and SRL. Although the instructors recognised teaching for SRL was challenging, they perceived that being more knowledgeable about SRL theory enabled them to sustain changes in their teaching practice. The instructors left the study wanting to continue to build knowledge and skills related to supporting SRL in their courses.

Chapter Eight: Key Findings, Considerations and Future Directions

With the overarching goal of advancing teaching and learning concerning SRL in postsecondary settings, my study explored a unique approach to contextualizing supports for SRL in undergraduate science courses. This approach was anchored in collaborations with five university instructors to inform their situated teaching practice with SRL theory and research. Throughout the study, the instructors engaged in collaborative and individual inquiry about their SRL-focused teaching practice. They learned about, designed, and embedded SRL supportive practices in their science undergraduate courses, observed how their students took up these opportunities to engage in SRL, and shared their experiences of teaching for SRL in a Community of Inquiry. Together we built new understandings about fostering SRL in undergraduate courses. My study originated from evidence suggesting that teaching towards SRL in content courses is one way in which university instructors can support students to navigate university learning demands (Hadwin & Winne, 2012; Ferreira et al., 2021; Steiner, 2016). Additionally, I perceived the potential of empowering university instructors to mobilize SRL theory and research through their practice to bring sustainable instructional changes to university classrooms and make supports for learning more accessible to students. In this chapter, I link the key findings of this study to the literature and discuss contributions to theory and research, and implications for practice. I also consider limitations of my study and point to directions for future research.

Key Findings

How did instructors infuse opportunities for SRL in their undergraduate courses?

Evidence emerging from my study showed each instructor infused (or identified, in Peter's case) SRLSPs in their courses in meaningful/context sensitive ways. By tailoring SRL supports to their courses, this group of instructors sought both to support their students to engage deeply with discipline-specific content and skills as well as to identify and develop their own strategic and adaptive approaches to learning (Hadwin & Winne, 2012; Hoops et al., 2016). Across courses, instructors created a variety of opportunities for students to develop and engage in SRL. They established participation structures that enabled active learning (e.g., through the syllabus); offered instructional supports (e.g., modeling,

metacognitive questions, feedback); established positive and productive interpersonal interactions inside and beyond the classroom (e.g., co-constructing knowledge); and implemented SRL supportive activities (e.g., process-oriented tasks that required planning, enacting strategies, monitoring, and reflecting). As a result, traditional undergraduate lecture courses were transformed into active learning spaces and supports for learning were made accessible to all students in undergraduate courses. However, as individuals with agency in my study, instructors also demonstrated that, supporting SRL can take multiple paths to a common outcome. For instance, Dana made use of multiple SRLSPs and embedded them in most activities (in and out of class), so opportunities for SRL permeated everything that students did in her course. Laura, Vicky, and Peter offered specific supports and opportunities for SRL as more isolated experiences; and Mike limited his supports to those made available in direct communication (e.g., questioning, feedback) with students.

My study reinforced the idea that instructors' involvement is essential in the development of SRL in undergraduate courses and that there is no single right way to foster SRL; rather, characteristics of the context in which learning unfolds can/should determine the shape and implementation of SRLSPs (Alvi & Gillies, 2020; Butler & Cartier, 2018; Ferreira et al., 2021; Greene, 2018; Perry et al., 2015). This finding demonstrates that situating SRL supports—inviting instructors to personalize their approach—is essential to meaningfully connect research-based frameworks to undergraduate teaching contexts and bring sustainable SRL teaching innovations to higher education settings (Foster, 2014; Halbert & Kaser, 2021; Perry et al., 2015; Penuel et al., 2020).

How did instructors perceive supporting SRL in their undergraduate courses and how did students experience the SRL opportunities offered in their courses?

A key finding of my study was instructors' perception that their capacity to bring SLRSPs to their courses was influenced—afforded and/or constrained— by interrelated sociocultural, contextual, and personal factors (i.e., systemic, student and instructor). These findings align with research suggesting that undergraduate organizational structures and culture in university academic disciplines and programs can

influence instructors' decisions to use practices that foster active learning (including SRL) in undergraduate courses (Ake-Little et al., 2020; Bathgate et al., 2019; Stains et al., 2018).

For example, aspects such as course structure/level, universal academic expectations, the provision of academic accommodations, and imposed content delivery/evaluation structures and procedures, made it challenging for some instructors to infuse their courses with autonomy supportive practices (e.g., engaging students in meaningful decision making, offering opportunities for students to control challenge, providing [in]formative feedback). These challenges were particularly salient in introductory and intermediate courses with multiple sections. In these courses, the focus was on covering content, the instructors had limited autonomy over the course design (e.g., they had to negotiate with colleagues what to include in assignments and assessments), and there were limited interactions with opportunities to get to know students. In addition, there was little room for negotiation to accommodate the level of difficulty or expectations to meet individual students' needs and interests. The CoI noted that student-centred instructional models (e.g., flipped classroom) and a small class size, typical of advanced courses, were affording settings to integrate SRL supports. Interestingly, the way in which Dana integrated SRLSPs in her advanced course fits descriptions of highly SRL supportive K-12 classrooms where researchers found educators had relatively more autonomy over the curriculum design, class sizes were smaller, and expectations were flexible (Perry et al., 2015; 2018; Perry, Lisaingo et al., 2020; Perry, Mazabel et al., 2020).

The instructors also linked time related factors (e.g., short academic terms, limited class time relative to the content to be covered and/or for interacting with students) to differences in how they designed and implemented SRLSPs. This finding is consistent with research suggesting that time, or lack thereof, influences faculty efforts at infusing courses with learner-centred teaching approaches (Marincovich, 2007; Wieman, 2017). The CoI perceived that offering consistent and meaningful opportunities to engage in SRL was incompatible with their fast-paced learning environment; students need time and sustained support to develop and adapt effective approaches to learning (Butler et al., 2008). This conclusion invites a reflection on potential cultural shifts in higher education institutions that

would enable instructors to infuse their teaching with SRLSPs and provide students with enough time to adapt their learning skills to successfully navigate university learning.

Regarding factors that may influence how students respond to opportunities to develop and engage in SRL, findings in my study showed that both instructors and students perceived as relevant the way SRLSPs were implemented. This supports previous work probing instructors' and students' perspectives about the effectiveness of SRL supports to foster student learning (Baird et al., 2015; 2020; Dugdale, 2021; Hu, 2020; Pekkarinen et al., 2020). For example, both the instructors and students perceived that implementing SRLSPs in a uniform way (e.g., scaffolding every problem in the same way because that scaffolding approach has previously been shown to support SRL) was less effective than letting both parties assess when and how SRLSPs were necessary. Likewise, consistent with previous research (Butler et al., 2008; Katz & Assor, 2007; Kirschner et al., 2006; Reeve, 2006; Zimmerman, 2002), too much choice, decision making and metacognitive questioning, without adequate support or solid prior knowledge, were perceived by participating students as overwhelming and unhelpful for their learning. This evidence strengthens the idea that instructors' involvement in tailoring SRLSPs to their teaching context is essential to creating meaningful and consistent opportunities for the students' engagement in SRL (De Corte, 2016; Perry & Rahim, 2011). Moreover, it highlights the notion that not all students will interpret and experience opportunities for SRL, tasks, and contexts similarly as personal characteristics (i.e., motivational, social, cognitive, emotional, metacognitive) affect the way learners interpret and recognize them (Butler et al., 2018; Hadwin et al., 2018; Perry, 2013).

Instructors in my study thought that variation in how students took up some of the SRL supportive opportunities they offered might have been influenced by beliefs and expectations about teaching and learning at university. The students may bring these beliefs and expectations with them or construct them as they participate in university programs; these beliefs may be reinforced by the higher education culture and traditions (Butler et al., 2008; Lynch & Hennessy, 2017; Pintrich & Zusho, 2007; Weller, 2019). Research indicates that prevalent teacher-centred approaches (i.e., traditional lecturing) and evaluation structures (i.e., grading) in higher education influence students' motivation for

approaching learning intentionally, strategically, and critically (Baird et al., 2015; Tannock, 2017; Wieman, 2017). Findings in my study supported this idea and invite a reflection, and further research, on how these systemic factors may influence students' perceived value and uptake of supports for learning.

Despite variations in how students took up SRLSPs, the instructors in my study observed overall positive outcomes in participation and performance, and that some students showed more deliberate approaches to tasks and learning in response to SRLSPs than they had observed in the past. This corroborates research linking contextualized SRL supports to enhanced SRL skills, academic engagement and outcomes for postsecondary students (Baird et al., 2015; 2020; Bendall & Kehoe, 2011; De Corte, 2016; Ferreira et al., 2021; Theobald, 2021), and warrants further research about which students are keen to take up the SRL supportive opportunities presented in their courses and how to reach those who are less enthusiastic.

Finally, my study demonstrated that instructors' practical expertise, including their disciplinary and contextual knowledge, and students' unique experience with SRL supports, are important considerations for advancing SRL teaching and learning in higher education. Also, my study invites further research on ways to make the university learning landscape more learner-centred, as well as more work to identify practices and tools that university instructors can adapt to fit the demands and constraints that undergraduate settings present to teaching for SRL.

What roles did a Community of Inquiry (CoI), as a collaborative structure, and individual inquiry, as a process, play in helping this group of instructors translate and mobilize SRL research in their practice?

Findings emerging from my study showed that combining research-based collaborative inquiry with individual inquiry as a self-study approach was helpful to empower participating instructors as experts to mobilize SRL theory into their practice as an academic term unfolded. Through this approach to professional learning, the instructors infused and integrated their previous teaching practices with the experience and new understandings gained from our work together. As a result, each of the instructors [re]framed their teaching through an SRL lens, and to different extents, this transformed their practice (Drago-Severson & Blum-Stefano, 2018; Timperley, 2011).

Professional development experts suggest that exploratory capacity building processes can bring feelings of uncertainty and vulnerability (Halbert & Kaser, 2021). Belonging to a learning community (i.e., CoI) where the instructors were positioned as valuable contributors of situated expertise, as well as learners, eased the instructors' feelings of uncertainty in their exploration of teaching for SRL. The CoI provided a structure where they felt validated in their efforts as well as safe and supported to share with their colleagues both failed and successful attempts at mobilizing SRLSPs into their courses. These findings support research demonstrating that professional learning opportunities that honour the practical expertise of educators and offer opportunities to engage in meaningful social reflection and knowledge sharing are critical to enable educators to animate theory into their practice, challenge the effectiveness of their pedagogical routines, and bring sustainable solutions to educational issues (Butler & Schnellert, 2012; 2020; Coburn & Penuel, 2016; Darling-Hammond et al., 2017; DeLuca et al., 2015; Foster, 2014; Pekkarinen et al., 2020; Perry et al., 2015; Stoll, 2009; Timperley, 2011; Weller, 2019). Moreover, findings from my study are consistent with evidence suggesting that educators' engagement in shared and individual situated cycles of goal-directed action and reflection about their teaching practice (i.e., much like the cycle of strategic action) can lead to transformative and sustainable changes in teaching and learning (Butler & Schnellert, 2020; Halbert & Kaser, 2021; Perry et al., 2015; 2018; Timperley et al., 2014; Yee et al., 2019).

Engaging with university instructors in collaborative and situated knowledge creation through inquiry addressed a pervasive challenge in educational research, as it helped bridge the research to practice divide for this group of instructors (Halbert & Kaser, 2013; Perry et al., 2015; Penuel at al., 2020; Randi & Corno, 2007; Stoll, 2009; Timperley, 2011). In line with research concerning factors enabling educators' use of research-based teaching (Bathgate et al., 2019; Darling-Hammond et al., 2017; Foster, 2014; Wieman, 2017), evidence from my study demonstrated that supporting university instructors to learn about SRL principles and practices, as well as having dedicated time, space, and guidance to put into practice their new understandings, was productive to develop a way of thinking about their teaching that is sustainable over time. Through our partnership, we advanced understandings of situated supports

for SRL in undergraduate courses, and instructors advanced their teaching practice with new knowledge and experience. These findings are relevant because they can inform pedagogical training and educational change initiatives that seek to enhance teaching practice and learning in postsecondary contexts.

Contributions to Theory and Research

My study contributes to theory and research about SRL and advances understandings about approaches to professional learning in postsecondary settings. Together these contributions hold promise for enhancing teaching and learning in higher education. Regarding contributions to SRL theory, my study demonstrated that SRL, viewed as a teaching and learning framework, is helpful to understand and proactively address academic challenges that students may face in higher education. In this sense, SRL provides one framework to accomplish current priorities in postsecondary education—it can help instructors to support students' deep and effective engagement with content in their discipline-specific courses and help students to navigate university and life-long learning expectations (Hadwin & Winne, 1996; Steiner 2016; Wieman, 2017). Reciprocally, priorities for teaching and learning in postsecondary settings create an ideal context in which to study SRL in situ. Examining the instructors' process of infusing their teaching with SRL supports, and their perspectives about it, advanced understandings about contextual and personal influences to making SRL supports more widely available to postsecondary students. In addition, it advanced understandings about SRL and its relationship to common teaching and learning approaches in higher education (e.g., inquiry learning, assessment for learning, critical thinking, active learning; Ambrose et al., 2010; Freeman et al., 2014). Also, my study demonstrated that SRL supportive principles and practices, extending from classroom-based research (Perry 2013; Perry et al., 2018; Reeve, 2006; Stefanou et al., 2004), are a useful vehicle for instructors to reframe their teaching and support SRL in university classrooms.

My study extended current understandings about what kinds of professional learning in postsecondary settings are needed to bring relevant and sustainable instructional changes to higher education (Foster, 2014; Pekkarinen et al., 2020; Wieman, 2017), but also if we want supports for SRL to be widespread in these contexts. In contrast to transmission style professional development opportunities

(Timperley, 2011), I implemented an SRL-informed capacity building approach that actively involved university instructors in their learning while offering them ongoing support, a learning community, and space and time to mobilize theory through practice. This approach has been used in some K-12 educational jurisdictions (Butler & Schnellert, 2020; Perry et al., 2015; 2018; Timperley et al., 2014) but is not common in universities. I brought together effective models for professional learning —situated, collaborative and individual inquiry (Butler & Schnellert, 2020; Halbert & Kaser, 2021), and embedded SRLSPs (Perry et al., 2018) to support instructors' engagement in learning about SRL theory and research. The CoI provided space for co- and shared-regulation of learning (Hadwin et al., 2018). It also created a safe and supportive community in which instructors, learned about the SRL framework and co-constructed meaning about teaching for SRL in undergraduate courses. This joint activity informed but did not replace the instructors' individual inquiry (i.e., cycles of action, reflection, adaptation). Individual inquiry processes required instructors to be deeply metacognitive and strategic and enabled them to be agentic in the process of learning about SRL and transforming teaching and learning in their courses.

Much of the research about SRL in postsecondary settings has been done using experimental, quasi-experimental, and mixed methods approaches (see Jansen et al., 2019; Theobald, 2021). I drew on qualitative, case study and classroom-based participatory approaches to research more commonly used in the K-12 educational system (Alvi & Gillies, 2020; Beaumont et al., 2016; Butler & Schnellert, 2020; Perry et al., 2015; Schnellert et al., 2008; Yee et al., 2019). This contributes to the relatively small body of qualitative research about SRL in postsecondary settings (e.g., Butler, 1998b; Foong et al., 2021; Hoops et al., 2016; Steiner, 2016). My sophisticated research design led to new and deeper understandings of how to support SRL in postsecondary settings by considering both instructor and student voices as centred in their unique and situated teaching and learning experience (Butler & Cartier, 2018; Hu, 2020). This naturalistic approach to research also presented advantages to understanding SRL supports in undergraduate courses by generating ecologically relevant evidence, building local capacity to advance SRL teaching and learning, and acknowledging the multi-determined, dynamic, and iterative nature of SRL (Butler & Cartier, 2018; Zusho, 2017). Moreover, my study shows how participatory and

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collaborative research designs can simultaneously examine and enhance teaching and learning at this level of education. I established a reciprocal partnership with university instructors in which, both their practical and contextual expertise and my SRL theoretical expertise were essential to advancing their situated teaching practice as well as our understandings of situated supports for SRL in undergraduate courses. This study demonstrated the value and viability of using research-practice partnerships (Coburn & Penuel, 2016) to think about, design, and evaluate context-relevant solutions to enhance educational practice in postsecondary settings—solutions that could foster sustainable systemic changes.

Limitations and Considerations for Future Research in the Field

There are limitations to what can be inferred from/explained by all studies, based on the design and methodological choices researchers make. My study is no exception. Therefore, it is relevant to consider some of my study's limitations, in addition to its contributions, and to highlight areas for future research emerging from this work. Here I focus on issues relating to my sample of university instructors and students, and how assessments of students' engagement in SRL can support evaluations of the efficacy of efforts to support SRL in university courses.

I partnered with pedagogically astute university instructors from a faculty where initiatives to improve teaching and learning were common. While instructors in my study might have not personally participated in these initiatives, their faculty/departmental culture and their personal interest in the scholarship of teaching and learning supported what I was asking them to do. While my study benefited from this select sample, it is necessary to try my approach to contextualizing supports for SRL in undergraduate courses with instructors who bring different needs for knowledge, beliefs, and levels of interest concerning SRL, and more broadly about student-centred pedagogical approaches. Such work would acknowledge the complexity of engaging with instructors in teaching as situated inquiry, advance teaching and learning in university settings, and inform pedagogical training and continued faculty development. Future research about classroom-based supports for SRL in postsecondary settings would also benefit from partnering with instructors belonging to departments/ faculties supportive and non-supportive of pedagogical innovation as well as from different academic disciplines or professional

programs (e.g., Medicine, Law, Pharmacy). Such partnerships would offer a more nuanced picture of how university instructors infuse supports for life-long learning across academic domains and programs to advance theory about teaching and learning within postsecondary settings. In addition, such work would be instrumental to further explore the affordances and constraints that higher education sociocultural and local contexts bring to shaping teaching practice and influencing student engagement in effective and adaptive forms of learning.

While my study considered both the instructors' and the student' voices as centred in their unique teaching and learning experience (Hu, 2020; Pekkarinnen et al., 2020), enhancing student data collection procedures would yield more robust findings. I offered the instructors autonomy over the process of assessing students' engagement in SRL in their courses. Some instructors approached this through surveys or by designing SRL-focused tasks that collected traces of students SRL activity (e.g., Dana), but most instructors monitored their SRL-focused teaching through less tangible (i.e., unrecorded) observations and reflections of what appeared to be going on for their students. Overall, instructors wanted to be more confident that their students were indeed self-regulating for learning, or that the impact they observed on the students' participation and performance was linked to their SRL-focused teaching. Working with instructors to design assessments of SRL at different points in time could better inform both instructors and students about the quality of SRL going on in their courses. For example, designing context-relevant diagnostic tools, such as weekly logs, where students can record their plans and document their goal attainment, feelings, challenges, and/or use of strategies in relation to specific learning tasks (e.g., Hadwin et al., 2019; Fabriz et al. 2014) can both enrich instructors' perspectives/teaching and foster student engagement in SRL, as Panadero et al. (2016) suggest.

Student data collection was not planned at the outset of the study and three limitations arouse during our efforts to gather useful information from students. Firstly, recruitment occurred towards the end of the academic term, which likely accounted for the small student sample. Consequently, this sample may not be representative of the diversity/positionality of students enrolled in courses where these innovations were taking place. While the data I collected from students was rich and informative, a more

nuanced picture of student perspectives requires gathering the perspectives of more students and/or delving deeper into the experiences of a small number of students who are selected as representatives of particular groups (e.g., high/low achieving students, students requiring accessibility services, students from various linguistic and cultural groups, students with different SRL profiles). Future work should consider including students who are demographically diverse from the beginning of the academic term to ensure a more representative sample.

Second, the small sample of students presented a limitation at the time of linking instructor and student perspectives more tightly. Specifically, I was faced with two different frames of reference in relation to their perspectives about the effectiveness of SRLSPs to make a difference in student learning (i.e., instructor perspectives about all their students and individual student perspectives on their personal experience). Since instructors' SRL focused teaching practice (and their perspectives about it) was my main focus, I decided to foreground their points of view but to enrich these with student data. Future work seeking to relate instructor and student perspectives about the effectiveness of learning supports on performance and participation would benefit from linking participants' points of reference more closely.

Lastly, I collected a few work samples from participating students in each course to examine their engagement in SRL but could not include these data in the analysis process. In two courses I required the instructors' support and disciplinary expertise to interpret traces of SRL in these work samples (e.g., answers to midterm questions or math proofs homework assignment). However, given the small student sample, reaching out to instructors could have broken the confidentiality agreement I had established with the students. Future work would benefit from involving both instructors and students in data analysis and interpretation (Nind, 2011) to understand student situated engagement in SRL. Collaborating with instructors on developing contextualized tools to assess SRL engagement in their courses could be one way to both inform teaching practice and collect rich and useful student data in future studies. Likewise, inviting students to engage in inquiry about their learning in learner-supportive content courses and keeping track of their academic outcomes and trajectories as they take control of their learning (e.g., through SRL, inquiry or experiential learning, critical thinking) could be instrumental to assess learning

outcomes across time and contexts. Lastly, using pre- and post- measures of SRL could reveal students'
progress in SRL.

Implications For Practice

My study contributed rich context-sensitive evidence to support high quality teaching and
learning at the undergraduate level, which I cluster in two interconnected recommendations for practice.
First, giving instructors agency to meaningfully connect research-based frameworks to their teaching
contexts is necessary to enable them to foster deliberate and adaptive approaches to learning in
undergraduate courses. Universities can strengthen their initiatives to shift undergraduate education
towards student-centred teaching approaches by maximizing the affordances and minimizing the
constraints that instructors perceived were influential in their efforts to bringing supports for SRL to their
courses. This would involve thinking differently about undergraduate teaching as well as developing a
culture where structures (e.g., departments, colleagues, promotion criteria, work conditions) support
instructors to learn about and try pedagogical innovations in their teaching.

Centres for teaching and learning can play a relevant role in fostering such culture change by
empowering instructors to experience professional learning as research-informed collaborative and
individual inquiry about teaching (e.g., through communities of reflection and practice that examine and
experiment with educational innovations). Positioning instructors as agents of educational change within
their classrooms as well as in relation to their own professional learning is promising to meet the broader
goals of teaching and learning in higher education. Instructors hold local and disciplinary expertise—they
know what it means and what it takes to be strategic and flexible or to think critically within their fields of
study. Pairing this expertise with the expertise of others (e.g., from faculties of education or units on
campuses that support learning) has transformational potential to bring sustainable changes to individuals'
teaching practices and, over time, generate systemic changes to teaching and learning in undergraduate
education.

Second, making supports for learning consistent and explicit within content courses is necessary
to help undergraduate students recognize and take advantage of opportunities to develop and engage in

active and adaptive learning to succeed in and beyond university. This would involve a shift in the culture of what is expected to teach and learn in undergraduate courses/programs that, over time, could result in valuable instructional change with long-term positive outcomes for students.

Instructors can accomplish such shift within their content courses by integrating multiple supports for learning to meet their goals and their students' needs as academic terms unfold. To this end, instructors should optimize their teaching practice by re-thinking the function of typically available resources/tools (e.g., syllabi, clickers, learning management systems, moving blackboards, discussion boards, open applications) as dynamic vehicles to anchor their focus on teaching students how to learn, create continuity between in class and out of class work, and maximize their in-class efforts to foster the development and use of life-long learning skills (Eberly et al., 2001; Richmond et al., 2016; 2019). Moreover, instructors should help students recognize learning activities within their courses as opportunities to learn how to learn within and beyond their disciplines, which can motivate them to engage with these processes and approach learning strategically. To this end, instructors can design and implement activities that engage students in thinking about how readily useful these are for them as well as to make explicit connections to the larger context of their courses and programs of study (Stefanou et al., 2013; Wieman, 2019). Importantly, it is essential that instructors offer students ongoing support (e.g., through feedback, modeling, strategic questioning) and provide them with consistent opportunities to develop and practice life-long learning in their content courses.

Concluding Thoughts

I began this dissertation with a description of Cali, an undergraduate student struggling to meet university learning demands. Like other undergraduate students, she was expected to know how to learn and was not offered explicit opportunities to develop the skills she needed to take charge of and manage her learning in her content courses. This study used SRL as a teaching and learning framework to support university instructors to help students, like Cali, develop and engage in effective approaches to learning within their content courses. Supporting instructors to become familiar with SRL teaching and learning principles and practices and to actively engage in tailoring, trying, and evaluating this 'new' pedagogical

knowledge was productive to enhance the quality of teaching and learning in their undergraduate courses. Importantly, by considering both instructors' and students' perspectives and needs concerning supports for learning to make postsecondary teaching and learning more accessible and inclusive, we gained a deeper understanding of situated SRL supports. This was useful to advance theory and research concerning SRL, to expand student-centred teaching practices in postsecondary institutions, and to inform professional training initiatives for faculty.

This study opened a door to developing a cohesive student learning support approach within postsecondary institutions whereby discipline-specific instructors and academic learning support units and programs work synergistically to help students learn how to learn within and beyond their fields of study. In this way, targeted academic support programs and structures (e.g., individual/small group support services, success courses) can optimize their resources to meet student learning needs. Overall, positioning instructors as agents of change has the potential to strengthen equity, diversity, and inclusion initiatives in postsecondary institutions and transform higher education policies and practices by better aligning qualities of teaching with teaching and learning demands in the university landscape.

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Appendix A. General Information Questionnaire

Part A

Please complete the following questionnaire. If there are questions you would prefer not to answer that is fine.

Name: Date (MM/DD/YY):

Gender: Ethnicity:

Department/Faculty in which you teach:

Section A. Teaching Background
1. Years of teaching experience at the university level:
     2. Do you have formal teaching education?
          ☐Yes
          ☐No

     3. Disciplines/domains in which you teach:

Section B. Focus of Inquiry: Course Context
1. What is the course you will be focusing your inquiry on?

     Course subject:

     Course level (e.g., 100,200; introductory/advanced):

2. How many years have you taught this particular course?

3. Approximate number of students typically enrolled:

Section C: Teaching this course
1. What are your strengths for teaching this course?

2. Do you experience any particular challenges in teaching this course? Explain.

3. Briefly describe your general approach to teaching and evaluation in this course.

Part B
Please complete the following questionnaire. If there are questions you would prefer not to answer that is fine.

Name:	Date (MM/DD/YY):

Section A. Course Context
4. What is the course you will be focusing your inquiry on during this academic term?

> Course title:
>
> Course code:
>
> Day(s)/time you teach this course?
>
> Room number:

5. Number of enrolled students this academic term:

6. What do you know about enrolled students? (as reported/declared in the FSM system)

Please do not report on individual students, just give a sense of the students (as a group) in your course.

> a. Gender (total of Female):
>
> b. Year in program (majority):
>
> c. Majors:
>
> d. Are you aware of students working with the Access and Diversity Center?
>
> ☐ Yes (approximate number of students:)
> ☐ No

Appendix B. Community of Inquiry (CoI) Reflection Templates

Finding a Focus, Making a Plan
Adapted from templates produced by S. Jerofsky in Changing Results for Young Readers

Instructor:	Date of CoI Meeting:
Question/Focus:	
Context: What will you do to answer your question? (Feel free to use point form, but elaborate enough for me to get a sense of what you are expecting/wanting to do/see.)	
React and interpret: How will you know you are making a difference? What will "success" look like?	

Record of Actions and Reflections

Adapted from templates produced by S. Jerofsky in Changing Results for Young Readers

Instructor	Date of CoI Meeting:
Question/Focus	
Context: What did you try? (This can be in point-form. If you used specific resources, list them.)	React and interpret: Was it effective? Why do you think it worked? What did you try that didn't work as you expected? Why do you think it didn't work? What did you learn about teaching and learning generally? What did you learn about supporting SRL?

Observations. How are your efforts at promoting SRL affecting your students' engagement and performance? List and describe briefly any "evidence" you consider relevant (e.g., the quality of students' assignments is better; class attendance is more consistent; you're assigning higher grades or getting fewer requests for clarification overall).	Reflect and Plan: What will you try next? What help could you use? Would you like to change your inquiry question? Where appropriate, briefly note the reasons for your choices/decisions.

Appendix C. CoI Meeting Check-Out Slip

What about the meeting today was useful for you? Did you learn something new, or get a chance to address some of your goals and questions?
What's one thing you might reflect on, observe, or try out before our next meeting?
What suggestions do you have for our next meeting?

June 28, 2017 – Added questions

1. When do you want to meet again? (Late August, Early September, Late September)
2. Would you like to meet with me individually? Yes / No

September 28, 2017 – Added questions

1. When is a good day to visit your classroom? (October 2-6; October 9-13)
2. Is October 26 a good day for a group meeting? Yes   No
3. What time are you available?

November 3, 2017 – Added questions

1. What's your availability to meet in the First week of December?

December 6, 2017

1. What about the meeting today was useful for you?
2. What's one thing you might reflect on, observe, or try out in your teaching next term?

Appendix D. Classroom Observation Protocol

(Based on Perry, 1998; 2013; Butler et al., 2017)

Observer _____   Classroom ID _____

Date _____

Beginning Time _____   Ending Time _____

Section A. What is the instructor's plan to support SRL in this session? (to be gathered in person or via email before observing).

What are you hoping to accomplish? What are your goals for the session?

Section B. Running Record

Description of Activity:

(What's going on?)

Section C. Debrief Interview (to be gathered on site or via email/Skype; questions may vary to fit the situation after each observation)

(Referring to their plans/intentions as expressed in Section A of this document). Do you think you met your plans and intentions? What contributed to or limited the success? Will you continue to use XXX tactic/strategy in the future?

How do you think your efforts at supporting SRL (give examples from observation) affected students' engagement and performance during this session?

What didn't work? Why? Will you adapt it in any way? What will you do differently?

Section D. SRL Promoting Practices

SRL Promoting Practices		Coding (0,1,2)	Example
Environment	Fostered a community of learners		
	Positive, non-threatening space for learning		
	Participation structures enabled active learning		
Activities/Tasks/ Assignments	Included multiple instructional goals		
	Were authentic/meaningful		
	Extended over time		
	Engaged students in aspects of the cycle of strategic action (SRL)		
Instructional support Co-Regulation	Presented students with opportunities for choice and decision making		
	Presented students with opportunities to control challenge		
	Involved students in individual and/or social forms of learning		
	Offered scaffolding		
Assessment and Feedback Practices	Included student self-assessment and opportunities to refine/revise strategies and work products		
	Engaged students in dialogue about learning processes		
	Provided formative feedback (could be from instructor or peers)		
	TOTAL Quality of SRL Support		

Each practice obtains a code of 0, 1 or 2.

0= no opportunity to observe/not in evidence during the observation

1 = observed (e.g., a choice was given) but not supportive of SRL (low quality)

2 = observed and supports SRL (high quality)

Everything is coded (to avoid losing data and to be able to identify that some aspects of SRL promoting practices are used more frequently than others).

Description of categories

Environment

Fosters a community of learners: Instructors and students are partners in knowledge building. Students' strengths, challenges, interests and needs are valued, recognized, accepted and accommodated. Peer-to-peer collaboration is supported, the classroom is a caring environment, diversity is recognized, big ideas are addressed through inquiry processes (planning, acting, reflecting, communicating, and adapting).

Positive, non-threatening space for learning: Classroom and teaching/assessment interactions are positive and non-threatening. Mistakes are learning opportunities (errors are not public and have low cost); students feel in control of their learning over progressively positive outcomes and growth is emphasized (learning takes effort and time, support seeking is encouraged, formative assessment is used). Motivational messages attribute success to effort and using good strategies, encourage progress and growth, and communicate confidence in students as learners. Students are challenged.

Participation structures enable active learning (choice, control over challenge): Expectations (roles, rights and responsibilities) and norms of engagement for different activities are explicitly discussed and/or co-constructed with students and accommodate diversity; predictable routines for participation are established / co-constructed. Instructor is alert to students' experiences of different norms and routines and/or supports students in generating strategies for achieving challenging tasks. Different ways of participating are valued.

Activities/tasks/ Assignments

To obtain a rating of 2, activities/tasks or assignments have most of the following features:

Multiple instructional goals: Activities involve several goals (e.g., learning content, higher-order goals; using/developing collaborative work skills). The goals should relate to/build on one another/

Authentic: Activities are meaningful for learners (e.g., real-world meaning; inquiry-based, project-based, contextualized), integrate content and skills, promote understanding of what it means to think and act like a mathematician, scientist, poet/writer. Engages students in learning/thinking about big ideas (deep and varied content; integrate content across subject areas). Activities offer students opportunities to experience challenges.

Extend over time: Activities are process oriented over time, requiring learners to plan, sequence their thinking and learning processes, and overcome challenges.

Engages students in aspects of the cycle of strategic action: Students are required to interpret tasks, set goals, identify expectations, plan (i.e., choose and coordinate resources), use strategies adaptively and flexibly (i.e., select, adjust, generate strategies), and/or monitor and refine their approaches (i.e., offer multiple opportunities for self-evaluation of progress, allow students to go through the same task more than once). Engagement in cycles related to different aspects of their performance (cognition, relationships, motivation, emotion).

Instructional Support/Co-regulation

Opportunities to make choices and decisions: Students are offered opportunities to take control over their learning by choosing and making meaningful decisions (i.e., research topic, ways of presenting, resources and learning strategies to use, where to work, who to work with). Choices require students to ponder the demands of tasks, reflect on their learning strengths and challenges and decide on learning approaches. Lower quality choices have constraints or involve low levels of thinking (e.g., you can do a or b) (1)

Control over challenge: Students are offered opportunities to control the level of challenge (e.g., oral presentation vs. written exam, learning goals for activities, co-construct performance criteria, involvement in self-assessment, generating feedback for peers). The level of difficulty presented by tasks/activities, or the expectations regarding the products of tasks/activities, were the same for all students (0), modifications or adaptations were made by the instructor (1), modifications/adaptations were made by students, or negotiated between teacher and students (e.g., co-construct criteria) (2).

Involve individual and/or social forms of learning: Foster both individual and collaborative work. When working with others students have the opportunity to articulate their ideas, think about themselves and others as learners, and learn with and from others (e.g., peer to peer support, co-regulation, socially shared regulation, socially responsible self-regulation).

Scaffolding: Instructor supports/guides learning (through co-regulation and/or socially shared regulation; modeling, clear and explicit instructions, strategic questioning). Bridge from guiding learning (structured, systemic and explicit supports) to encouraging independence (activities are sequenced in a ways that support this transition).Students are offered opportunities for reflection on their learning (i.e., the strategies they used and why, how they and others felt about learning, particular subject area skills, values and beliefs about learning, offering opportunities to teach to others, summarize in their own words). Students are supported to apply knowledge and skills flexibly and creatively (e.g., critical thinking, problem solving). Guided, action or experiential learning is used.

Assessment and feedback practices

Self-assessment and opportunities to refine/revise strategies and work products: Engages students in self-assessing the quality of their work in progress (according to learning goals) and

required next steps/adaptations. Criteria lists and rubrics for students to guide their performance paired with opportunities to talk about these with peers or instructor. Instructor offers opportunities to evaluate or reflect on their work but the substance of the evaluation is mechanic (1); if it is meaning related (is it interesting, does it make sense? What did you learn?) (2)

Engage students in dialogue about learning processes: Directs students' attention to thinking and learning processes while engaged in activities (e.g., strategic questioning, KWL, think-pair-share, whole – class discussion). Students are given the opportunity to refine their learning approaches based on information from assessments (by instructors, peers, themselves).

Formative feedback (could be from instructor or peers): Provides targeted, focused, just in time support and feedback so they can identify and reduce differences between progress and goals. Feedback is descriptive (what's working? What's not working? What's next?) and given in the context of activities. Feedback focuses on the task, causes thinking (students interpret it and use the information to advance their learning, promotes dialogue) and surfaces learning goals (where am I going?). Peers give effective feedback to each other (e.g., discussing their work, constructive dialogue about work, peer editing).

Appendix E. Instructor Exit Interview

These questions are intended to guide the conversation between the researcher and instructors about whether and how (a) their teaching practice developed/changed cross the study; (b) they perceive their focus on SRL has helped them to support their students; and (c) using SRL promoting teaching practices in their courses impacted their students' engagement and learning. This is a flexible protocol and I am not committed to asking every question or asking them in the order they appear. Also, additional, but related, probes may be added to support the conversation (e.g., for clarification, or elaboration). Instructors will be prompted to report general information about the class, not information that could lead to the identification of particular students.

1. How has your participation in the Community of Inquiry affected or changed your experience of teaching (e.g., engagement in teaching, efficacy for teaching)?

2. How has your participation in the Community of Inquiry changed your general approach to teaching (e.g., beliefs about teaching; understandings about the needs of your students; your planning for other courses; the way you interact with students in them; assignments)?

3. How will your participation in this study change your teaching of [course title] in the future?

4. What strenghts and challenges do you see in the practices associated with supporting SRL (e.g., giving student choices, involving them in self-assessment) for enhancing students' engagement and learning in [course subject]?
   Would these be the same in other courses you teach?

5. What do you perceive affords and constraints the implementation of these practices in [course subject]?
   Would these be the same in other courses you teach?

6. Overall, how do you perceive an SRL approach to teaching [course title] helped you support your students?

7. How do you think your participation in this study impact students' engagement in [course title]?

   a. Is there one SRL supportive practice you found particularly effective for helping your students engage in [course title] (Note: I will allow instructors to name more than one approach/strategy if they want to. If they generate a list I will ask them to rank their top 3/favourites).

8. How did your participation in this study impact students' learning in [course title]?

   a. Is there one SRL supportive practice you found particularly effective for helping your students learn in [course title] (Note: I will allow instructors to name more

than one approach/strategy if they want to. If they generate a list I will ask them to rank their top 3/favourites).

9.   Did you notice any changes in academically at-risk students' engagement and learning compared to other students in the classroom? What kind of changes?

10. Is there anything you would like to add or comment upon?

Appendix F. Student Interview Protocol

Goal: As much as possible, I want students to use their own words to describe what they perceive their experience of self-regulated learning (SRL) was in the course they took with instructors participating in my study. This will help my interpretation of whether and how the course and instruction supported their self-regulating learning.

Format/Procedure: I have framed open-ended questions to begin the discussion about learning/SRL, but I am not committed to asking every question or asking the questions in the order they appear in this protocol. Follow up questions will prompt clarification/specification and/or elaboration.

I will establish and facilitate the discussion around the topics of interest. A graduate research assistant (GRA) with knowledge in the field of SRL will be there to assist with equipment and refreshments, arrange the room, take notes so that I can focus on the discussion, and debrief with me at the end of the session.

Each session will last approximately 60 minutes.
An introduction at the beginning of the session will include: (a) Welcome, (b) overview of the topic, and (c) ground rules/norms of participation.

> *"Hi everyone and thanks for taking the time to join us to talk about supports for learning in university courses. My name is Silvia Mazabel and this is [name of assistant]. Both of us are graduate students in the Faculty of Education here at UBC.*
>
> *As you know, for my doctoral research, I worked with [instructor name] who taught you [course title]. S/he belongs to a group of instructors in the Faculty of Science who are interested in supporting students in their courses to be more active, engaged, and in control of their learning (e.g., to be more involved in making decisions about course content or assignments or approaches to learning). In this session, I want to hear directly from you about your experience in this course.*
>
> *There are no right or wrong answers but different points of view. Please feel free to share your point of view even if it differs from what others have to say. Also keep in mind that this is not a course or instructor evaluation.*
>
> *You've probably noticed the voice recorders on the table. I am audio recording the session because I don't want to miss any of your comments and I want to have my full attention in the conversation.*
>
> *We can call each other by our first names but I will use pseudonyms or refer to 'participating students' when I present data from this focus group. Please complete a name card so we can remember each other's names.*
>
> *Are there any questions about the purpose and procedure?"*

Questions:

1. *Was your learning experience in this course different to experiences you've had in other courses you have taken at [University name]? If so, how?*

2. *[Instructor's name] implemented various teaching strategies throughout the term in [course title]. I'm interested in whether you perceived the teaching strategies s/he offered were opportunities to be more autonomous and active as a learner, and how you responded to those opportunities.*
      [If it doesn't come up, I will ask participants what they understand about autonomy for learning]

   What things (could be tasks, activities, participation structures, instructional sequences) in the course helped or didn't help you to be an active, autonomous learner? How did these things affect your motivation for learning?
      i. Can you provide a particular example?
      ii. How did this help or not help?
      iii. How did it affect your interest in [subject matter]?
      iv. How did it affect your motivation for learning?
      v. How did it affect your approach to the [task, activity, participation structure, instructional sequence]?
   If students are short of responses, I will probe more deeply, mentioning practices I observed in classroom visits that I perceived (based on my knowledge of theory and research about SRL) are supportive of SRL.

   For example, how did you experience being able to choose how to approach the worksheets in class? You had the option of completing the worksheets: (a) on your own, in pairs, or in a group; (b) electronically or on paper; (c) using different resources; and (d) at your own pace.

      i. How did this help/not help?
      ii. How did it affect your interest in [subject matter]?
      iii. How did it affect your motivation for learning?
      iv. How did it affect your approach to …?

3. I will prepare chart papers for specific teaching strategies that instructors explicitly implemented in the course with the purpose of supporting SRL. Strategies could be related to specific assignments or activities; how content was delivered; how feedback was given; how the course was structured; student/instructor and student/student interactions in the classroom; domain specific strategies; and dialogue about learning in class. Each focus group will reflect on different strategies depending on what instructors did during the course.

   The Figure below shows one example of what the chart papers might look like. In this case, the instructor asked students questions that required them to reflect on how they prepared for the

midterm exam and based on their experience in the midterm, how they would continue to participate and prepare lectures, and prepare for a second exam. Clickers were the tool she used of this exercise. Below the figure is the script I will use to introduce this activity.

"We will continue with a short activity. Here you see some chart papers with some teaching strategies written on them. You will: (a) indicate whether your instructor used that strategy; (b) indicate if you think the teaching strategy supported you to be an active, autonomous learner; (b) comment on how the strategy affected your motivation to learn; and (c) comment on how that specific teaching strategy influenced the way you approached learning.
Each of you has a different coloured stack of sticky notes. Write your comments on your sticky notes and then affix your sticky notes to the appropriate chart with the teaching strategy."

Once students are finished this activity (approx. 10 minutes) we will come together as a group. I will summarize their comments on the sticky notes and will ask for clarification/elaboration on how these practices were and were not helpful as needed.

    a.   Tell me more about how helpful/unhelpful [specific practice]was
          i. How did it affect…
                 the way you study?
                the way you prepare for class?
                the way you participate in class?
                the way you approach learning?
    b.   Is there anything you would add or change to make [specific practice] more effective?

Closure

    Is there anything we didn't mention that you think supported your learning/SRL in this course?

Appendix G. Contextualized Student Interview Protocol

Laura

1. Probes:
   a. How did you experience the opportunity to work on several examples in class where you had the choice of working on your own or with pairs? Small groups then whole group?
   b. How did you experience the way she modeled how to solve problems (using document camera and talking at the same time)
   c. How did you experience the way she asked you questions so you got to the solution on your own?
   d. How did you experience the way she used your contributions in class to further explain different topics?
   e. How did you experience the leading questions on Piazza that encouraged you to reflect?

2. Chart paper activity
   a. After presenting us a non-standard problem, Laura shared with us some graphs on how students and mathematicians worked a difficult problem. She explained the importance of problem analysis and planning and showed us all the steps to solve a difficult problem.
   b. As part of an assignment, we were asked to identify and address our mistakes on the midterm so we could avoid them in the future. We characterized the mistakes we made on the midterm (e.g., algebra or arithmetic error; not understanding the question; not knowing how to apply a concept; careless mistake, etc.), created a list of errors and thought what types of errors we were prone to. We then thought on strategies to improve in these areas.

   c. In class, we worked on a worksheet that focused on problem solving (planning, approaches and verifying answers). We could choose which problems to work on depending on how useful they were for us (e.g., to master concepts, to reinforce understanding, to challenge ourselves) and we didn't get a solutions sheet.

Dana

1. Probes
   a. How did you experience being able to collaborate with peers in class discussions and out of class (for example in preparation for Monday discussions, worksheet about an article, or doing the peer review for the final project draft)?
   b. How did you experience being able to choose your topic of interest and experimental approach for the final project? Or topics for the second half of the course?
   c. How did you experience working on a long term project, drafting and reflecting on your progress as you the term went by?

2. Chart paper activity
   a. In the last few classes we did some group work around particular experiments where we had to make predictions/suggest approaches for experimenting based on data that Dana gave us. She asked us to: work with someone we hadn't worked with before; decide how we would work as a group; share with each other what we understood about the task.

b. Dana talked about SRL in class and throughout the term she invited us to reflect on our work, our approaches to learning and doing things. For example, she gave us the R&R assignments, asked us to reflect on our progress or about how group work went in the assigned article worksheet. These are some questions she asked us: What have you learned about yourself as learner? How would you describe your progress so far? As a group, how did you proceed? Was the strategy successful?

Mike

1. Probes
   a. How did you experience the atmosphere in class? (welcoming, jovial, knowing your name)
   b. How did you experience the way he introduced topics? Like he would check for background knowledge, telling you why that particular topic was relevant and how it applied in different situations
   c. How did you experience the extra non-credit exercise problems that resembled the examples in class but were different so you could have more practice
   d. How did you experience the way he used your contributions in class (correct and incorrect) to build proofs?

2. Chart Paper Activities
   a. In class, Mike explained every step of a proof using simple and then more complex examples and specifically mentioned why we were doing the things we were doing. He also gave us different strategies so we didn't get confused with notation.
   b. In class he invited us to give him ideas about how to start or continue a proof and included our ideas in the proof. He asked us questions and we discussed whether something would work or not in a proof.

Vicky

1. Probes:
   a. How did you experience being able to choose how to approach the worksheets in class? You had the option of completing the worksheets: (a) on your own, in pairs, or in a group; (b) electronically or on paper; (c) using different resources; and (d) at your own pace.
   b. How did you experience having the opportunity to work on many examples (i.e. in class) in small groups during class (With Vicky and TA's help) and then solve the problems as a whole class with Vicky's guidance?
   c. How did you experience getting tips on how to do well in this course (e.g., watching videos actively, typing as you watched, rework lecture problems, practice before seeing solutions, use errors as opportunities for learning, seeking help if you get stuck, trying out different options).
   d. How did you experience the way the class was structured? (watching videos/screencasts with the content and then practicing in lecture, lab and through practice problems?)

2. *Chart paper activity*
   a. Vicky asked questions that invited us to reflect on our preparation for the midterm. Questions also asked us to consider whether and how we would participate in the course (e.g., participate in class, approach assignments) in the future and how we would prepare for the other midterm. We used clickers to respond.

I found the material on the midterm… easy, ok, hard

Given the length of the midterm, I need this much more time…

The way I prepared for the midterm was useful (y or N)

I will change how I prepare for the next midterm (y or N)

I want to change how I prepare for and participate in lecture (y or n)

b. Vicky modeled how to solve problems in class. She did it going step by step and asking us questions on what would come next in the code. She included our answers in the flowcharts and if there was a mistake she would explain why that would or would not work. She also gave us strategies like testing the paths to make sure they work or different ways to keep track of what we were doing.