Spring 2021

Formation of a Professional Learning Community to Promote Metacognitive Teaching: An Action Research Study

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FORMATION OF A PROFESSIONAL LEARNING COMMUNITY TO PROMOTE METACOGNITIVE TEACHING: AN ACTION RESEARCH STUDY

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Submitted in Partial Fulfillment of the Requirements

For the Degree of Doctor of Education in

Curriculum and Instruction

College of Education

University of South Carolina

2021

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DEDICATION

This work is dedicated to my family, friends, and colleagues who have supported me along this journey. My husband, Michael, has encouraged me and been the support I needed to excel in my studies. I could not have done this without him. I have to thank my son, Mitchell, for testing my grit and tenacity by arriving early and during my data collection. Despite many sleepless nights with a newborn, he has given me the motivation to finish strong.

ACKNOWLEDGMENTS

I must first acknowledge my advisor, Dr. Yasha Becton, for her guidance throughout this process. She has helped me to craft my dissertation and create a work that I am proud of. I would also like to thank my committee, Dr. Christopher Bogiages, Dr. Bridget Miller, and Dr. Suha Tamim, for their support and invaluable feedback.

Thank you to my colleagues who graciously participated in our "Hall Meetings" twice each month. I loved being able to share and grow with all of you, despite the distance between us during the pandemic. You all have made me a better teacher, and I have so much more to learn from each of you.

It has taken many eyes and ears to finalize this work. Thank you to my mother for her hours of proofreading and to my friends for answering my pleas for help finding the perfect synonym when I am at a loss for words.

ABSTRACT

This mixed-methods action research study examined how implementing a Professional Learning Community (PLC) supports the development of metacognitive teaching. Participants were 10 technical college science instructors. While PLCs are common in K-12 education, they are less employed at the postsecondary level. There is a gap in the literature regarding PLCs in the context of postsecondary education, and the metacognition of postsecondary level educators. A PLC was used as an intervention over a 15-week semester to aid in the development of metacognitive teaching for higher education faculty. Instructor use of metacognition was assessed using pre- and post-quantitative surveys, open-ended questionnaires, and interviews. The study's results supported literature that suggests that instructors vary in their metacognition, and the PLC fosters metacognitive growth. Data provided evidence that instructors had an awareness of their strengths and weaknesses, but they were not as skilled at changing how they teach. Results of the research study indicated that instructors became more self-aware and improved in the domains of declarative knowledge and procedural knowledge. The PLC may be a place where instructors gain awareness of their strengths, enabling them to compensate for their weaknesses. Additionally, qualitative data implied that the PLC supported deeply personal and meaningful professional development, transformative learning, and critical self-reflection. The triangulation of quantitative and qualitative data suggested that instructors may have experienced a cognitive bias leading that was mitigated by metacognitive growth experience in the PLC. By further developing

metacognition, instructors paradoxically acknowledged their limitations, allowing them to better recognize their strengths and weaknesses, leading them to make changes that led to improvement. Likewise, decreases in scores on metacognitive survey instruments suggested that instructors were better able to self-assess after the PLC intervention. Collaboration within the PLC enhanced self-regulation by reducing feelings of isolation, validating the experiences of instructors, and motivating them to make instructional changes.

Keywords: metacognition, professional learning community, science, technical college

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LIST OF ABBREVIATIONS

MAI ..... Metacognitive Awareness Inventory

MAIT ..... Metacognitive Awareness Inventory for Teachers

PLC ..... Professional Learning Community

STC ..... Suburban Technical College

CHAPTER 1

INTRODUCTION

Metacognition is a skill that aids in learning and includes regulation of one's own cognitive activities and awareness of one's knowledge (Flavell, 1979; Schraw & Dennison, 1994). The significance of the role of metacognition as it relates to the improvement of student learning, thinking skills, and academic success is well-documented (Adey & Shayer, 1993; Dang et al., 2018; Kuhn & Pearsall, 1998; Zepeda et al., 2018). Metacognition, cognition, and motivation are components of self-regulated learning, understood to be how one comprehends and adjusts learning (Schraw et al., 2006). Students with highly developed metacognition are better able to self-regulate and engage in their own learning processes, require less effort to learn, are better able to transfer knowledge, and are more motivated (Pintrich, 2000; Schraw et al., 2006; White et al., 2009; Zepeda et al., 2018). There is evidence suggesting that individuals with less developed metacognitive skills do not perform as well academically as those who possess more developed metacognitive skills (Dunning et al., 2003; Kruger & Dunning, 1999). Openly discussing and teaching students about metacognition may help them become more successful learners (Cummings, 2015; Maclellan & Soden, 2012; Pelton, 2014; Pintrich, 2002; Tanner, 2012; Zohar & David, 2008). There is abundant research in primary and secondary education to support the pedagogical recommendation of explicitly teaching metacognition to students, especially in science education (Ben-David & Orion, 2013; Seraphin et al., 2012; Thomas & Anderson, 2014; Zohar & Dori, 2012).

Support of metacognitive development helps students develop critical thinking, problem-solving and aids in high levels of conceptual growth (Ben-David & Orion, 2013; Zepeda et al., 2018; Zohar & Dori, 2012). There is less research about the explicit teaching of metacognition at the postsecondary level (Hartman, 2001; Tanner, 2012), and even less is known about the metacognitive strategies of students and instructors in postsecondary career and technical education.

To support students' use of metacognition and self-regulation in their learning, educators themselves must have knowledge and awareness of metacognition (Kallio et al., 2017; Kramarski et al., 2002; Prytula, 2012). Like students, educators may vary in their ability to utilize metacognition and may not use a metacognitive approach to thinking about their teaching (Tanner, 2012; Zepeda et al., 2018). At the postsecondary level, college instructors may be subject-area experts but may not be able to use or transfer a metacognitive stance toward their teaching (Tanner, 2012). There are various degrees by which instructors are metacognitively aware and self-regulate to change their instruction to suit student needs. The difference between how instructors address their assumptions about students may lie in their ability to think metacognitively about teaching. Instructors must also regulate their teaching to support students' development of self-regulation in their learning (Kallio et al., 2017; Kramarski et al., 2002). Instructor metacognition should be used to reflect upon one's teaching practice since teaching metacognitively may be the beginning of improving one's teaching practice (Tanner, 2012). Previous studies show that new and experienced educators benefit from professional development that focuses on expanding metacognitive strategies (Prytula, 2012; Seraphin et al., 2012). The findings of these studies demonstrate that instructors

can learn to use metacognitive knowledge strategically but must be supported in their development to do so (Prytula, 2012; Seraphin et al., 2012).

Statement of the Problem

Within the context of the research setting, formal professional development opportunities are provided twice per year by the Suburban Technical College (STC; pseudonym used), the research site for the present study. Topics in professional development sessions focus on subjects common to all full-time and part-time faculty and staff, and new faculty orientation typically concentrates on institutional processes, policies, and procedures. Additional professional development regarding teaching for both new and veteran instructors is typically carried out “in house” by small groups of instructors who share the same interests or curriculum areas. Teaching experience is a preferred qualification for full-time faculty; yet, it is not required for employment. Consequently, additional professional development often is needed to develop instructors' pedagogical skills; however, without structured and well-planned professional development to improve pedagogy, instructors may not know how or what to change with respect to their teaching. The Problem of Practice in this action research study is that instructors at a two-year technical college are content experts but may not use metacognition to improve their teaching.

Instructors vary in their metacognitive approach to thinking about teaching and, like students, they may vary in their ability to utilize metacognition (Tanner, 2012). Moreover, instructors may be unaware of their current skill level with regard to pedagogy and may overestimate instructional quality and student engagement. Without being able to accurately self-assess, instructors do not know how or what to change. Faculty

professional development benefits educators in learning metacognitive strategies (Seraphin et al., 2012), and a Professional Learning Community (PLC) may be an environment that fosters metacognitive growth (Prytula, 2012). This study investigated how collaboration and discussion via the formation of a PLC impacted the development of metacognitive teaching practices in technical college science instructors.

Research Question

This action research study explored the impact of a PLC on the metacognition and teaching practices of 10 science instructors at a two-year technical college. The following research question was investigated to address the purpose of the study and examine the Problem of Practice:

> How can the implementation of a Professional Learning Community (PLC) by college science instructors support the development of metacognitive teaching?

Theoretical Framework

This study was grounded in the metacognitive theory of Flavell (1979) and the concept of Professional Learning Communities as initially described by DuFour and Eaker (1998). These theories shaped the lens by which the study was designed and tied together the Problem of Practice with the research question and selected methodology.

Metacognition

Metacognition may be defined simply as thinking about thinking (Flavell, 1979). There are multiple perspectives regarding what metacognition entails, expounding on the original definition of the term by Flavell (1976). For the purpose of this research study, a two-component model was used to inform this study. The two-component model of metacognition is widely used by researchers and includes metacognitive knowledge and

metacognitive regulation (Kallio et al., 2017). Pintrich (2002) defined metacognitive knowledge as "knowledge about cognition in general, as well as awareness of and knowledge about one's own cognition" (p. 219). It may include knowing which strategies to use for different tasks, when the strategies are to be used, and how effective those strategies are (Pintrich, 2002). Metacognitive regulation is understood to be how a person regulates and adjusts their cognitive activity to best fit a circumstance (Kallio et al., 2017). Despite numerous definitions, it is generally emphasized that metacognitive regulation includes planning, monitoring, and evaluating one's thoughts and learning processes (Flavell, 1979; Tanner, 2012).

Metacognitive Awareness

Metacognitive awareness is one subset of metacognition, identified as a key element needed for one to develop autonomy in learning and teaching (Balcikanli, 2011). Metacognitive awareness allows an individual to "plan, sequence and monitor his or her learning so that the improvements can be seen directly in performances" (Kallio et al., 2017, p. 79). Generally, studies support the notion that educators differ in their level of metacognitive awareness, and those differences arise from experience, age, and educational level (Kallio et al., 2017; Mai, 2015).

Professional Learning Communities

The second theoretical framework used to support this study was the Professional Learning Community (PLC), as described by DuFour and colleagues (1998; 2016). A PLC is a group of educators who collaboratively work together to reflect upon their practice, develop pedagogy, and undergo professional development centered on improving student learning (DuFour et al., 2016; DuFour & Eaker, 1998; Servage, 2008).

Work within a PLC should be collective, and inquiry and problem-solving should apply to teaching practices (DuFour et al., 2016; Servage, 2008).

The PLC promotes a democratic ideal due to shared leadership and decision making, with a strong sense of community, centered on benefitting student learning (Hord, 2009; Senge, 2012; Servage, 2008). Servage (2008) asserted that within the PLC, it is essential "to consider the extent to which teachers themselves must undergo transformation if substantive and sustainable change will occur" (p. 67). Servage (2008) described the PLC as a "psychologically safe place" (p. 68) where transformative learning can occur and that the PLC may create conditions by which people are able to self-motivate. The PLC fosters critical reflection and critical pedagogy, and it creates an environment where individuals feel worth (Evans, 2001; Senge, 2012).

Purpose of the Study

The purpose of this action research study was to examine how the enactment of a PLC by technical college science instructors aided in the development of metacognitive teaching. The study assessed how metacognition was used in instruction before and after the intervention since metacognition may not be natural for instructors to use with respect to their teaching (Tanner, 2012). Explicit instruction of metacognition may help students become more successful learners (Cummings, 2015; Maclellan & Soden, 2012; Pelton, 2014; Tanner, 2012; Zohar & David, 2008); however, instructors must possess knowledge and awareness of metacognition in order to self-regulate their teaching and support student learning (Kallio et al., 2017). During this process, the participant-researcher and PLC participants explored the use of metacognition in their teaching and the effect the PLC had on their perception and use of metacognition.

Although much research has been conducted regarding the metacognition of K-12 students, less is known about college students, and information on the metacognitive awareness of college instructors is even scarcer. A current gap in the literature exists with reference to the metacognitive awareness of two-year technical college instructors. The overarching goal of this study was to examine the impact of the PLC on college science instructors as they incorporated metacognitive strategies into their instruction.

Overview of Methodology

A mixed-methods action research methodology was utilized to study the Problem of Practice as the participant-researcher worked with 10 science instructors to implement the PLC on campus. Action research allows research participants to connect theory to practice, improve their craft, and foster their own professional growth (Mertler, 2016). This methodology was well-suited for the democratic nature and action orientation of the PLC (Mertler, 2016). Educators participating in a PLC work collaboratively in a continuous process of action research and inquiry to provide a better education for their students (DuFour et al., 2008; Mertler, 2016). The fusion of a PLC and action research has many benefits for educators. This integration is empowering as it provides opportunities to systematically enhance one's practice while developing the skills needed to improve teaching continuously. The combination of a PLC and action research affords PLC participants the opportunity for professional growth tailored to themselves in their unique context (Mertler, 2016). Action research was the ideal approach to foster change within the local setting, empower the individuals involved, and ensure the intervention was meaningful and personalized to research participants (Efron & Ravid, 2013; Mertler, 2016).

The open-ended nature of the Problem of Practice and research questions were best suited for a mixed-methods approach to examine the various facets of the research question. In this study, a mixed-methods methodology was necessary to involve participants and to use results from quantitative survey data to shape discussions within the PLC, engage participants, and bring about change (Creswell, 2014; Creswell & Plano Clark, 2018). Qualitative data was necessary to study instructor metacognition and collect information while allowing participants to self-reflect on their teaching practices.

Positionality

An action researcher's positionality defines how they view themselves within their research with respect to the research participants (Herr & Anderson, 2015). The participant-researcher's positionality with reference to the participants in this study determined the power relations and trustworthiness of the findings (Herr & Anderson, 2015). The positionality of the participant-researcher changed with time and perspective, bringing up the matter of multiple positionalities where the participant-researcher's status of an outsider or insider may be subject to the many lenses used to examine their role as an action researcher (Herr & Anderson, 2015). Objectively and critically addressing these multiple positionalities is essential to candidly addressing any personal bias and how it affects the trustworthiness of the data of the present study's findings.

When the PLC was discussed initially with the participants, the participant-researcher was a biology instructor. However, one semester prior to the initiation of the PLC, the participant-researcher was promoted to Division Chair of the science department. The plans for the PLC were finalized in a department meeting where the participant-researcher proposed the PLC as a method to improve communication and

collaboration while providing a space to improve professional practice. At the time the research was performed, the science department was in a state of turmoil: in the midst of the COVID-19 pandemic, a period marked by undue stress and isolation, the department was without a dean or higher leadership aside from the participant-researcher as Division Chair. Still, the positionality of the participant-researcher best fits the model of insider collaboration for participatory action research (Herr & Anderson, 2015). The role of "insider" or "outsider" is not a fixed position and changes depending on the view taken. The participant-researcher was an instructor at the institution and, until three months prior to the formation of the PLC, had the same job title and responsibilities as the participants in the study. Yet, because of the participant-researcher's new leadership role, they may be seen as an outsider. During the data collection phases of this study (Phase I and Phase III, detailed in Chapter 4), the participant-researcher assumed the role of "outsider," collecting data from the research participants. During the intervention phase (Phase II, detailed in Chapter 4), the participant-researcher acted as an "insider" by taking part in the PLC and initiating an action research cycle with their peers. This allowed the participant-research to assume an objective stance, as researcher, as well as a subjective stance, as participant.

Significance of the Study

This study has the potential to provide insight into the areas of PLCs and metacognition at the postsecondary level, specifically within career and technical education. The formation of PLCs has been slow to move to the postsecondary level, and formal research regarding the utilization of PLCs within colleges is scarce. While the term "Professional Learning Community" has become conventional, the execution of a

PLC and its processes in their true form are less common (DuFour et al., 2016). The structure of the PLC was novel in the context and setting of this research study. Postsecondary faculty are often isolated in their profession and value their autonomy (Y. Zhao, 2013). Even at other levels of education, educators may fear judgment from colleagues and may be hesitant for others to observe or participate in their classrooms (Johnson & Donaldson, 2007). There is a gap in the literature concerning PLCs organized by two-year technical college faculty.

The fundamental purpose of the PLC is a focus on student learning (DuFour et al., 2016). If an organization, such as a technical college, is to help students learn effectively, then the instructors must also focus on continual learning (DuFour et al., 2016). PLCs have great potential for impacting student achievement by helping to transfer the focus of educators toward student support (DuFour et al., 2016). By shifting the work of educators from isolation to collaboration, they may also change how they respond when students do not demonstrate proficiency (DuFour et al., 2016). Information about the implementation of a PLC in this study may give an understanding of the effects the PLC had on technical college faculty. This form of professional development has the potential to transfer to other contexts. Audiences that may benefit from this study include educators from all levels who may want to implement a PLC or utilize metacognitive teaching, from K-12 to two- and four-year colleges and universities.

There is a gap in the literature concerning metacognitive awareness and the use of metacognition of instructors in postsecondary education, especially regarding technical and vocational education (Kallio et al., 2017); however, some studies have investigated teachers' metacognition in K-12 education. It can be argued that college instructors who

do not utilize a metacognitive approach to teaching, or "teaching metacognitively," may vary in their metacognitive awareness, metacognitive knowledge, and self-regulation. It should be noted that to support students, instructors must understand how students learn, and they should be aware of their own metacognitive abilities to help students improve their skills (Kallio et al., 2017).

This study is also significant because numerous studies have shown that explicitly teaching students about metacognitive strategies and teaching them to think metacognitively may help them to become more academically successful (Cummings, 2015; Maclellan & Soden, 2012; Pelton, 2014; Tanner, 2012; Zohar & David, 2008). Yet, the development and use of metacognition are not innate for everyone (Buoncristiani & Buoncristiani, 2012; Flavell, 1979; Pelton, 2014), and "around 30% of the adult population never engages in metacognition" (Buoncristiani & Buoncristiani, 2012, p. 21). In a diverse two-year technical college population, this is evident in both traditional-age students and non-traditional adult learners. However, individuals can learn to utilize metacognition and be purposeful in their thought processes (Cummings, 2015; Tanner, 2012; Whimbey, 1980). Moreover, this study helped to provide insight into issues of equity. The open-access nature of college admissions at the technical college provides educational opportunities for at-risk student populations (Shannon & Smith, 2006; J. L. Smith & Vellani, 1999). At-risk students academically improve when educators collaborate to improve curriculum, such as in the PLC (Burk, 2000; Kamler & Comber, 2005; Long et al., 2020; Minbiole, 2016). Additionally, evidence suggests that teaching metacognitively promotes equity in science education for low-achieving students and disadvantaged students (Dang et al., 2018; White & Frederiksen, 1998).

Limitations of the Study

Limitations of the study included the number of participants sampled (n = 10). This study generated knowledge that is not intended to be generalizable outside of its local context or to demonstrate external validity. Timing is another important consideration when discussing limitations. Instructors met only six times over the 15 week semester. Also, because of the COVID-19 pandemic, participants had to meet virtually to maintain the social distancing requirements of the research site. The PLC was completely new to the context of the technical college, and it was the first time a PLC was formed. Although this occurred virtually and developed over the course of a semester, it is plausible that examining the PLC over a longer period and with face-to-face meetings would yield more insight into the long-term effect of the PLC on technical college science instructor metacognition.

Dissertation Overview

The background was presented in Chapter One of this action research study. Chapter One described the Problem of Practice, Research Question, Theoretical Framework, Purpose of the Study, gave an Overview of Methodology, and discussed Significance and Limitations. Chapter Two presents a review of the relevant literature and will conclude by summarizing the major themes underlying the theoretical and conceptual frameworks. Chapter Three gives an overview of the mixed-methods action research methodology and include a plan for data collection, reflection with research participants as part of the Professional Learning Community, and the analysis plan for each phase of the study. Chapter Four contains the research findings and implications of the formation of a Professional Learning Community on the use of metacognition in

teaching. Chapter Five gives a summary of the study and its findings as well as the conclusions.

Definition of Terms

Action Research: a participatory and iterative research methodology in which the researcher identifies a problem of practice and gathers background information to collect, analyze, and interpret data to improve and understand their unique context (Efron & Ravid, 2013; Mertler, 2016).

Metacognition: thinking about one's thinking (Flavell, 1979). Metacognition includes planning, monitoring, and evaluating one's thoughts and learning processes (Flavell, 1979; Tanner, 2012).

Metacognitive Awareness: one subset of metacognition, allowing one to plan and monitor one's learning (Kallio et al., 2017).

Metacognitive Knowledge: general knowledge about cognition that drives cognitive tasks (Flavell, 1979). One-half of the two-component model of metacognition (Kallio et al., 2017). Metacognitive knowledge includes declarative, procedural, and conditional knowledge (Schraw & Moshman, 1995).

Metacognitive Regulation: how a person regulates and adjusts their cognitive activity to a given circumstance. Metacognitive regulation is comprised of monitoring, planning, and evaluating (Kallio et al., 2017).

Professional Learning Community: a group of educators who collaboratively work together to reflect upon their practice, improve teaching, and undergo professional development centered on the improvement of student learning (DuFour et al., 2016).

Self-Regulation: the ability to understand and control one's learning; self-regulated learning includes cognition, metacognition, and motivation (Schraw et al., 2006).

Teaching Metacognitively: teaching with metacognition to foster metacognition in students (Hartman, 2001); an awareness in one's metacognition to self-reflect upon teaching practices in order to benefit student learning (Tanner, 2012).

Transformative Learning Theory: an adult-oriented learning theory based upon the idea that each individual has a unique worldview (Christie et al., 2015; Mezirow, 1991). Transformative learning uses critical thinking, reflection, and questioning to address assumptions and misconceptions (Servage, 2008). This process uses one's experiences and intense critical reflection to challenge beliefs and assumptions for authentic learning to occur (Howie & Bagnall, 2013).

CHAPTER 2

LITERATURE REVIEW

The Problem of Practice examined in this action research study involved instructors at a two-year technical college who are content experts but may not use metacognition to improve their teaching. This study aimed to investigate how the formation of a Professional Learning Community (PLC) by technical college science instructors aided in the development of metacognitive teaching. Instructors vary in their application of metacognition to teaching, and like students, may vary in their ability to utilize metacognition (Tanner, 2012). Additionally, instructors may function in isolation (Chen & Miller, 1997), may be resistant to change (Evans, 2001), or lack professional development and opportunities for feedback and reflection. These factors may lead instructors to over-or underestimate their pedagogical skill level, instructional quality, and student engagement.

Explicit instruction of metacognition helps students become more successful learners (Cummings, 2015; Ku & Ho, 2010; Maclellan & Soden, 2012; Mytkowicz et al., 2014; Pelton, 2014; Rezvan et al., 2006; Tanner, 2012; Zohar & David, 2008); however, instructors must possess knowledge and awareness of metacognition in order to self-regulate their teaching and support student learning (Kallio et al., 2017). Faculty professional development benefits educators in learning metacognitive strategies (Seraphin et al., 2012), and a PLC may be an environment that fosters metacognitive growth (Prytula, 2012). Transformative learning theory aids in the explanation of how

the PLC assists in changing worldview and motivates instructors to incorporate metacognitive strategies into their teaching (Servage, 2008).

Chapter 2 is a review of the literature in which the causes and effects of instructor metacognition and teaching are examined through the frameworks of Metacognitive Theory and PLCs. Together, these frameworks connect research exploring metacognition with the role that instructors have in promoting student learning and the importance of explicit metacognitive instruction to foster an equitable learning environment. The following research question was posed to address the purpose of the study and examine the Problem of Practice: How can the implementation of a Professional Learning Community (PLC) by college science instructors support the development of metacognitive teaching?

A thorough review of the literature is critical in planning action research. Finding sources of information that inform the topic of investigation provides the opportunity for action research to connect prior research and existing theory to one's teaching practices. As part of the participant-researcher's search of the literature, the literature review helped to focus the study topic, develop the action research plan, and identify gaps in the literature (Mertler, 2016). The participant-researcher also identified methodologies and interventions that could be adapted to use in the study.

The literature search was guided by Mertler's (2016) description of the planning stage of the action research process and the complex literature review process described by Machi and McEvoy (2016). Online searches were conducted through Google Scholar and the University Library Catalog to access EBSCO and ERIC databases. Several books were accessed via Distance Education delivery. The participant-researcher used

combinations of search engine keywords such as *metacognition, professional learning communities, professional development, science education, college science,* and *technical education*. Results were limited to peer-reviewed journal articles, published reports, and books.

From the literature search, themes of metacognitive teaching, the use of the PLC to promote metacognition, and the link to transformative learning became clearer. The majority of research studies were performed on pre-service teachers or in K-12 education and showed an underlying theme of student achievement, equity, and social justice in science education. Information regarding the formation and implementation of PLCs was plentiful, although there were fewer studies that explicitly linked together PLCs with instructor metacognition and PLCs with transformative adult learning. The literature was further searched to find studies situated within the context of college science education. The participant-researcher identified several gaps in the literature pertaining to technical education as a whole and the metacognition of technical college instructors.

This literature review is organized into six sections, beginning with an examination of the historical context of the literature. Next, the theoretical framework that informs the dissertation is discussed. The next three sections review the relevant research and link together the dissertation's theoretical basis while discussing themes of *Teaching for Metacognition, Teaching with Metacognition,* and *Fostering Change within the Professional Learning Community*. The literature review concludes with a summary of how these frameworks weave together to inform the dissertation.

Historical Perspectives

The historical perspectives of the theories and concepts of this action research study helped the participant-researcher construct meaning throughout the literature review process. Metacognition has a long, complex history influenced by various theorists, such as James, Vygotsky, Piaget, and Dewey.

Metacognition

Flavell is most commonly credited with coining the term "metacognition" after he first introduced the concept of "metamemory" into the literature (Flavell, 1971, 1976). Flavell was responsible for the first modern studies of metacognition in children (Flavell et al., 1970). Since then, the definition and research of the construction of metacognition have been "fuzzy" (Brown, 1987, p. 66). Brown (1987) noted two problems with defining metacognition. The first is that it is hard to discern which psychological processes are cognitive and which are metacognitive since the two are related concepts (Brown, 1987). The second is that the origins of metacognition trace back far beyond the mid-to-late-1970s when "metacognition" gained popularity (Brown, 1987). The more modern, two-component model of metacognition, as described later in Chapter 2, is informed by the research and theorizing of John Flavell, Ann Brown, and Gregory Schraw, among others. The concept of metacognition, however, has historical roots that extend well into the early 20th century and beyond.

The Obscure Origins of Metacognition

Brown (1987) described metacognition as "not only a monster of obscure parentage, but a many-headed monster at that" (p. 105). In this statement, Brown (1987) referred to the need of researchers to further develop theories and procedures for studying

and defining metacognition. The overarching theme of metacognition in multiple constructs warrants further study to develop a full understanding, especially its entanglement with cognition and other concepts such as scaffolding, self-regulation, and self-reflection. The concept of metacognition extends beyond the 20th century, tracing back to classical theorists (Silver, 2013). Plato, for example, reported on cognizing one's cognition, and Simonides of Ceos purportedly created the idea of loci of memory (Dunlosky & Metcalfe, 2009; Noushad, 2008; Silver, 2013). In the 1690s, English philosopher John Locke wrote of the concept of children reflecting upon their own thought processes (Dunlosky & Metcalfe, 2009; Noushad, 2008).

The idea of self-reflection is found in the work of William James, Lev Vygotsky, Jean Piaget, and John Dewey (Fox & Riconscente, 2008; Silver, 2013). The constructs of metacognition and self-regulation are tightly entwined with other paradigms and are foundational to critical thinking (Silver, 2013). Fox and Riconscente (2008) compared and contrasted the perspectives of James, Vygotsky, and Piaget regarding how these differences in perspective of the same phenomenon add to the complexity of the construct of metacognition. In 1890, James wrote about metacognition in Principles of Psychology, referring to monitoring one's memory to retrieve information. James' description of introspective observation consisted of deliberately paying attention to one's thoughts and reporting them. Although James did not use the term metacognition, he utilized metacognition and self-regulation while practicing control of attention for introspective observation. This demonstration of thinking about thinking, for James, "means, of course, the looking into our own minds and reporting what we there discover" (James, 1980/91,

p. 185, as cited in Fox & Riconscente, 2008, p. 375). In this sense, James' metacognition and self-regulation are essentially intersecting acts (Fox & Riconscente, 2008).

The influence of Vygotsky on metacognition traces back to his theory of internalization (Brown, 1987; Fox & Riconscente, 2008). Vygotsky stated that learning creates the zone of proximal development, and learning occurs when interacting with others in one's environment with one's peers (Bråten, 1991b, 1991a; Brown, 1987). In the work of Vygotsky, metacognition takes the form of consciousness, requiring controlled attention and abstraction (Fox & Riconscente, 2008). Brown (1987) noted the pertinence of Vygotsky's theory is because "a great deal of learning occurs in the presence of, and is fostered by, the activity of others" (p. 100). Using Vygotsky's lens of cognition, metacognitive awareness and self-regulation are highly overlapping concepts, stating, "We use consciousness to denote awareness of the activity of the mind – the consciousness of being conscious" (Fox & Riconscente, 2008, p. 383). Expert learners can transfer skills of planning, monitoring, and evaluation necessary to develop metacognition and self-regulation in a novice learner (Bråten, 1991a, 1991b; Brown, 1987). Therefore, support and guidance by others are essential to the development of metacognition and self-regulation (Brown, 1987).

Piaget's theories on cognitive development influenced Flavell (1976) in the creation of the term metacognition. Piaget's Theory of Regulation and reflective abstraction profoundly impacted Flavell (Brown, 1987). Piaget's reflective abstraction "refers to the essentially human ability to step back and consider one's own cognitive operations as objects of thought; to reflect on one's own thinking" (Brown, 1987, p. 69). Flavell (1976) directly credited Piaget, citing "the crucial importance of this assembly of

integration process as a vehicle or mechanism of cognitive progress" (p. 231). Piaget proposed three types of self-regulation, including autonomous regulation, active regulation, and conscious regulation. In autonomous regulation, learners regulate performance and actions to meet a goal. Active regulation involves testing theories via trial and error. Conscious regulation requires a learner to imagine and produce new hypotheses using the evidence available. Moreover, mature learners can move from using autonomous regulation to active and conscious regulation in reflective abstractions (Brown, 1987). In terms of Piaget's four stages of cognitive development, the use of reflective abstractions, and therefore metacognition, would occur in the formal operational stage, beginning in adolescence and lasting into adulthood (Fox & Riconscente, 2008; Piaget, 1970).

Finally, Deweyan reflection is related to metacognition (Silver, 2013; Tanner, 2012). Dewey (1910) introduced the idea of reflective thought as "active, persistent, and careful consideration of any belief or supposed for of knowledge in light of the grounds that support it, and the further conclusions to which it tends" (p. 6, as cited in Silver, 2013, p. 6). Dewey (1933, as cited in Silver, 2013) outlined his process for reflective thinking, which educators use as part of metacognitive teaching practices. These steps of reflective thinking emphasize Dewey's belief that one learns more from reflection upon a learning experience than the learning experience itself (Silver, 2013; Tanner, 2012). As in the evaluation stage of metacognitive regulation, Deweyan reflection is significant to learning (Tanner, 2012).

A Consensus on Metacognitive Theory

Although it is hard to illuminate the exact origins of metacognitive theory, and researchers may disagree on its exact definition, it is evident that it plays a role in many cognitive processes. Flavell (1987) even acknowledged that the concept of metacognition could easily be broadened to extend beyond understanding cognitive processes. Flavell (1987) stated that concepts related to metacognition could include "executive processes; formal operations; consciousness; social cognition; self-efficacy, self-regulation; reflective self-awareness; and the concept of psychological self or psychological subject" (p. 25). These concepts are in addition to thinking, learning, and a person's cognitive development (Flavell, 1987). Since then, metacognition has become well-studied in a variety of contexts and fields. The attention given to metacognition since the 1970s is due to a consensus among researchers that metacognition plays an important role in understanding cognition, awareness, problem-solving, critical thinking, and learning. Research on metacognition has extended beyond understanding the development of learning in children to understanding how adults and children learn, how teachers can foster metacognitive skills, and even to neuroscience research on how metacognition forms during neural development from childhood to adulthood (Fleming & Dolan, 2012).

Transformative Learning: An Adult Learning Theory

Mezirow's (1981) transformative learning theory is unique in that it is an adult-oriented learning theory. In transformative learning, a disorienting dilemma, such as novel questions or an argument, is required to confront held assumptions and change an individual's perspective (Mezirow, 1981, 1991, 1997). The distress of the dilemma challenges the individual's worldview and may become a catalyst for personal and

professional growth (Mezirow, 1991). As transformative learning theory seeks to explain how adult learning develops as one's frames of reference change, Mezirow's theory evolved over time as he was influenced by various thinkers and researchers that contributed to his grounded theory. Throughout the writings of Mezirow (1981, 1991, 1997, 2000; Mezirow & Taylor, 2009), he credits the reconstructive approach of Piaget, Dewey and Deweyan reflection, Donald Schön and the reflective practitioner, and Flavell and metacognition.

Fostering Adult Learning Through Reflection

The adult learning process does not solely rely on the acquisition of new knowledge. For learning to become meaningful, novel information must be assimilated by the adult learner into a pre-existing frame of reference. Mezirow (1997) contended that for adults, transformative learning is an active process involving a change in their frame of reference, which involves their outlook, thoughts, and feelings. Frames of reference are transformed by critically reflecting upon one's assumptions on which their habits of mind, points of view, and beliefs are based. Individuals may have to be supported in their critical self-reflection for learning and change to occur (Mezirow, 1997).

Transformative Learning as a Metacognitive Endeavor

Transformative learning is inherently metacognitive (Dix, 2016; Mezirow, 2003; Mezirow & Taylor, 2009). For transformative learning to occur, an individual would have to engage in critical self-reflection and self-evaluation, something that requires significant introspection and metacognition (Dix, 2016; Lonie & Desai, 2015; Mezirow, 2003). Concerning transformative learning and critical reflection, transformative learning

is “metacognitive reasoning involving these same understandings but, in addition, emphasizes insight into the source, structure, and history of a frame of reference, as well as judging its relevance, appropriateness, and consequences” (Mezirow, 2003, p. 61). Dix (2016) goes so far as to argue that all transformative learning is essentially cognitive transformation, which must involve metacognition to reshape one’s cognitions and motivations. Additionally, practicing and encouraging transformative learning can help individuals grow professionally and develop metacognitive skills (Lonie & Desai, 2015). PLCs are one example of an environment that promotes metacognitive growth (Prytula, 2012) since PLCs may assist members in their transformative learning (Servage, 2008). Mezirow (1991, p. 212) posited that adult educators must establish communities within their settings where beliefs may be questioned or validated. Educators should foster transformative and emancipatory learning. They have a professional responsibility to ensure the commitment of instructors, offer educational opportunities for all learners, and extend the opportunity for critical discourse. It is only then that educators and students can actively participate in the transformative learning process, leading them to fully and freely participate in rational discourse, and participate in social change (Mezirow, 1991).

The Rise of Professional Learning Communities

Professional learning communities gained popularity in the 1990s, after the publication of Peter Senge’s (1990, 2012) book *The Fifth Discipline* and Donald Schön’s work on reflective practitioners (Hord, 1997). In *The Fifth Discipline,* Senge (1990) introduced the idea of learning organizations and team learning. Similar to transformative learning, Senge (2012) noted that profound change occurs in individuals when they experience an intense learning experience. Team learning is comprised of practices that

promote collaboration. In team learning, everyday communication is improved such that it is continuous, carried out with respect and reflection, and centers around the most important issues (Senge, 2012).

Learning organizations and team learning allow for nurturing the individual within an organization while engaging them in problem-solving and producing a shared vision for the organization and problem solving. With specific reference to team learning, PLCs provide an arena where educators can learn from one another (Senge, 2012). The application of these ideas to schools meant that change efforts could include all educators and school staff, helping combat resistance to organizational change while including them in the change process itself (Evans, 2001; Senge, 2012). Most of the impetus for this came from the long history of educators working in isolation. Outside of the context of a PLC, teachers worked with little to no communication with other faculty or staff. The PLC, then, allowed teachers to collaborate and combine their knowledge of pedagogy and curriculum design and allowed them to work together in a meaningful way (Hord, 2008).

One of the earliest researchers of PLCs was Susan Rosenholtz (1989), whose study found that collaboration and shared goals amongst educators led to improved teacher and student learning. Teachers were able to ascertain which policies and practices were most effective, and they had higher levels of commitment (Hord, 1997; Rosenholtz, 1989). Most importantly, teachers who felt supported in their work were more dedicated and influential (Hord, 1997). By the early 1990s, more studies were performed on highly-successful schools and the culture of the communities of educators within them. For example, McLaughlin and Talbert (1993) found that experienced educators were enabled

to share their wisdom and skill in teaching when they participated in collaborative inquiry.

Similarly, Little and McLaughlin (1993) reported that the most effective schools, and departments within those schools, operated as professional learning communities. Two years later, Newmann and Wehlage (1995) found that professional learning communities were found in the most successful schools. Schools that had a clearly stated purpose of promoting student learning also took collective responsibility for student success (Kruse et al., 1994; Newmann & Wehlage, 1995). Darling-Hammond (1996) concluded that successful schools shared decision making about curriculum design and teaching. By the late 1990s, the findings of these studies and others led DuFour and Eaker (1998) to clearly define what a PLC is and describe best practices for developing curriculum, professional development, preparation for teachers, assessment best practices, and school leadership. The PLC model by DuFour et al. (2016) has since become the standard practice for PLCs.

Theoretical Framework

This study was grounded in the metacognitive theory of Flavell (1979) and in the concept of PLCs as described by DuFour and Eaker (1998). These theories shaped the lens by which the study was designed and tied together with the Problem of Practice with the research question and selected methodology.

Metacognitive Theory

Metacognition, as initially defined by Flavell (1976), is "one's knowledge concerning one's cognitive processes and products" (p. 232). It includes the active monitoring, regulation, and adaptation of these processes (Flavell, 1976) and consists of

awareness of one's knowledge, thinking, and regulation of cognition (Schraw & Dennison, 1994; Zimmerman, 2002). Metacognition is a deliberate and goal-oriented management of cognition (Hacker et al., 1998), where a person actively manages their thoughts for a specific task and enhances learning (Novak, 1990; D. Wilson & Conyers, 2013). In this sense, cognition is how one interacts with objects, ideas, and abstractions and encodes, memorizes, and recalls that information (Schraw et al., 2006). Metacognition is how one controls and monitors these cognitive processes (Flavell, 1979; Frith, 2012; Holton & Clarke, 2006; Schraw, 1998; Schraw et al., 2006). More simply put, metacognition is thinking about one's thinking. Despite numerous definitions, metacognition is generally believed to include planning, monitoring, and evaluating one's thoughts and learning processes (Flavell, 1979).

The development of metacognition begins in childhood (Flavell, 1976), continues throughout adolescence, and finishes in adulthood (Zohar & Dori, 2012). This late cognitive development of metacognition is thought to be due to the maturation of the brain's prefrontal cortex, which matures in early adulthood at approximately 25 years of age (Fleming & Dolan, 2012; Qiu et al., 2018). Metacognition and knowledge of one's cognition may be context-specific (Efklides, 2008; Kuhn, 2000; Zohar & Dori, 2012). Adults have more metacognition than children and adolescents, but they may not be able to explain their knowledge of cognition or methods for selecting cognitive strategies (Zohar & Dori, 2012). Individuals may not have the ability to transfer specific knowledge to a new setting either (Tanner, 2012; Zohar & Dori, 2012). For example, individuals may use metacognition in learning science, but it may not transfer to teaching science (Tanner, 2012; Zohar & Dori, 2012).

Flavell, Miller, and Miller (2002) noted the division of metacognition into two categories: metacognitive knowledge and metacognitive monitoring or self-regulation. The two-component model of metacognition is widely used by researchers and is the model that informed this study since it distinguishes metacognitive knowledge from metacognitive regulation (Brown, 1987; Kallio et al., 2017; Schraw & Dennison, 1994; Schraw & Moshman, 1995; Young & Fry, 2008). This model and its components are illustrated in Figure 2.1. Metacognition is comprised of knowledge and awareness of thinking and the planning, monitoring, and evaluation of thinking (Zohar & Dori, 2012).

Metacognitive Knowledge

Metacognitive knowledge is one's general knowledge about cognition and awareness of one's knowledge (Pintrich, 2002; Schraw, 1998; Schraw & Moshman, 1995). For example, metacognitive knowledge includes knowing which strategy to use for a given task, when each strategy should be used, and how effective each strategy is (Pintrich, 2002). The individual using metacognitive knowledge must have a reflective understanding of cognitive processes and their role in them (Kallio et al., 2017; von Wright, 1992). The most commonly used model of metacognitive knowledge includes declarative knowledge, procedural knowledge, and conditional knowledge (Brown, 1987; Jacobs & Paris, 1987; Schraw & Dennison, 1994; Schraw & Moshman, 1995) and closely aligns with the traditional classifications of knowledge (Richter & Schmid, 2010). These aspects of metacognitive knowledge influence a learner's actions.

Declarative Knowledge. Declarative knowledge is knowledge about metacognition and of cognitive strategies (Pintrich, 2002). It is "knowledge about one's skills, intellectual resources, and abilities as a learner" (Zohar & Dori, 2012, p. 68). It

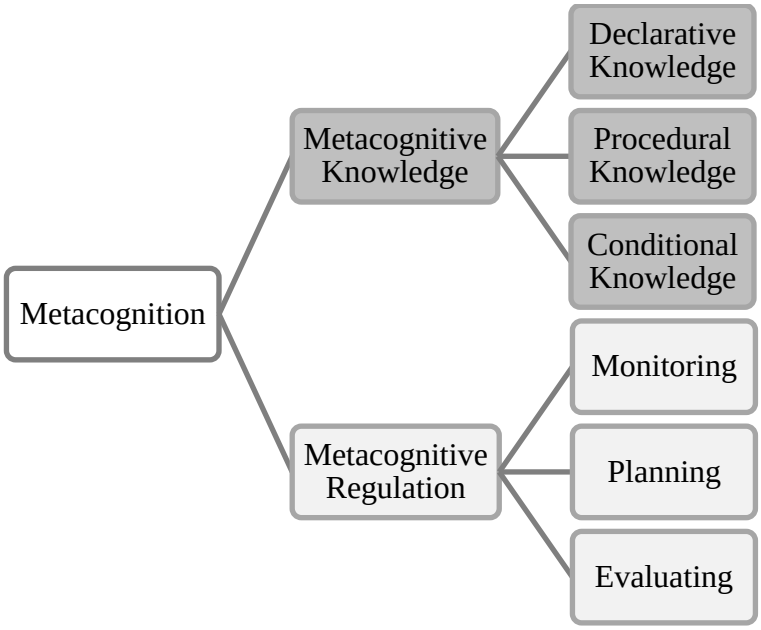


Figure 2.1 The two-component model of metacognition as informed by Schraw and Moshman (1995) and described by Zohar and Dori (2012).

includes one's memories and conceptions about knowledge (Schraw & Moshman, 1995) and one's knowledge and beliefs about persons, tasks, and strategies (Flavell et al., 2002; Zohar & Barzilai, 2013; Zohar & Dori, 2012). Zohar and Barzilai (2013) defined *knowledge of persons* as one's knowledge of what affects their cognition and the cognition of others. *Knowledge of tasks* relates to how one understands how the conditions of tasks and goals affect their cognition. Knowledge about strategies for problem-solving, learning, and thinking to achieve goals is knowledge of strategies (Zohar & Barzilai, 2013). These constructs are related as subcomponents of metastrategic knowledge, knowledge of when, why, and how to use tasks and strategies to accomplish goals (Kuhn, 2000; Kuhn & Pearsall, 1998; Zohar & Dori, 2012). Good learners are better at using their declarative knowledge, what they know about their memory and

cognition, to influence their performance (Schraw & Moshman, 1995). For example, one uses declarative knowledge when they reflect upon the limitations of their memory system. In terms of teaching metacognitively, an example would be an awareness of one's strengths and weaknesses as an educator (Balcikanli, 2011).

Procedural Knowledge. Procedural knowledge relates to the effective use of metacognitive strategies (Zohar & Dori, 2012). Sometimes referred to as metacognitive skills, procedural knowledge is the monitoring and self-regulation of one's cognitive activity (Schraw & Moshman, 1995; Zohar & Barzilai, 2013). It is related to declarative knowledge since procedural knowledge is one's knowledge about how to implement learning strategies (Schraw & Dennison, 1994; Zohar & Dori, 2012). Effectively using strategies includes "possessing a large repertoire of strategies, knowing how to sequence them and how to use qualitatively different strategies to solve problems" (Zohar & Dori, 2012, p. 200). Awareness of one's thinking processes impacts the outcome of one's performance and goals (Jacobs & Paris, 1987; Zohar & Dori, 2012). For example, students can apply strategies such as using mnemonics, self-testing, or outlining information to improve their learning. An application of procedural knowledge by instructors would be an awareness of the techniques one uses while teaching (Balcikanli, 2011).

Conditional Knowledge. Conditional knowledge is knowing when and why to use learning procedures in one's declarative and procedural knowledge (Zohar & Dori, 2012). It is connected to the affective domain of learning and metacognitive experiences (Schraw & Moshman, 1995; Zohar & Barzilai, 2013). Conditional knowledge allows one to assess the requirements of a situation and select the most appropriate strategy for that

situation. This knowledge is also closely related to the components of metastrategic knowledge and declarative knowledge (Kuhn, 2000; Kuhn & Pearsall, 1998; Zohar & Dori, 2012). An application of conditional knowledge that instructors may use is selecting the most specific teaching techniques for specific tasks (Balcikanli, 2011). Conditional knowledge for educators informs their pedagogy and can help instructors select the best strategies to enhance student learning (Hartman, 2001).

Metacognitive Regulation

Metacognitive regulation is understood to be how one regulates and adjusts cognitive activity to best fit a given circumstance (Kallio et al., 2017; Zohar & Dori, 2012). Schraw and Moshman (1995) considered metacognitive regulation to be "metacognitive activities that help control one's thinking or learning" (p. 354). It is more closely related to the actions and events that facilitate learning rather than the knowledge of them. Metacognitive regulation, then, involves the performance of metacognition (Schraw & Moshman, 1995). However, these regulatory processes may not be conscious or explicit and may be automated in adults (Zohar & Dori, 2012). Most models for the regulation of cognition include the components of planning, monitoring, and evaluation (Jacobs & Paris, 1987; Schraw, 1998; Schraw et al., 2006; Zohar & Dori, 2012).

Planning. Regarding metacognitive regulation, planning is the selection of appropriate strategies and background knowledge, distribution of resources, goal-setting, and managing time (Zohar & Dori, 2012). Planning allows an individual to control their learning experience depending on the context of the learning activity. In terms of one's metacognitive teaching strategies, planning could involve pacing oneself during instruction and setting teaching goals for a lesson (Balcikanli, 2011).

Monitoring. Monitoring involves one's "awareness of comprehension and task performance" (Schraw & Moshman, 1995, p. 355). Metacognitive monitoring is the ability to self-test and assess learning or strategy use (Schraw & Dennison, 1994). Through this process, a learner can assess progress and their strengths and weaknesses (Schraw & Moshman, 1995). Adults who are highly skilled learners, however, may be poor monitors in certain situations (Pressley & Harris, 2017), suggesting that metacognitive monitoring is independent of skill level. An example of monitoring while teaching may be assessing instructional techniques, teaching goals, and using formative assessments to measure student comprehension and learning (Balcikanli, 2011; Tanner, 2012).

Evaluation. Evaluation is one's appraisal and self-regulation of learning (Zohar & Dori, 2012). It is the assessment and judgment of one's goals and strategies used in learning (Schraw & Moshman, 1995). Individuals who are skilled at evaluation may also reevaluate goals after completing a task (Balcikanli, 2011; Schraw & Moshman, 1995). Metacognitive evaluation of one's teaching can help inform and improve one's pedagogical practices. It involves tasks such as reflection upon which techniques were effective and what should be changed the next time it is taught (Balcikanli, 2011).

Metacognitive Awareness and Self-Regulation. The concept of metacognition is highly entangled with other constructs (Silver, 2013; Zohar & Dori, 2012). This entanglement is due to what Brown (1987) described as the murky borders between cognition and metacognition, especially in scientific thinking and higher-order critical thinking (Zohar & Dori, 2012). Metacognition has also been linked to pedagogical content knowledge (Shulman, 1986), scaffolding (Holton & Clarke, 2006), self-reflection

(Silver, 2013), self-regulated learning theory (Schraw et al., 2006), and metacognitive awareness (Schraw & Dennison, 1994). At times, terms such as "reflection" may be used in place of metacognition; although they are technically different, scholars often use them interchangeably (Silver, 2013). Metacognitive awareness and self-regulation are discussed here since they informed the Metacognitive Awareness Inventory for Teachers (MAIT) (Balcikanli, 2011) used in the intervention described in Chapter 3.

Metacognitive Awareness. Metacognitive awareness is one subset of metacognition, identified as a fundamental component needed for one to develop autonomy in learning and teaching (Balcikanli, 2011; Kallio et al., 2017; Larson, 2009). Metacognitive awareness allows an individual to "plan, sequence and monitor his or her learning so that the improvements can be seen directly in performances" (Schraw & Dennison, 1994, p. 460). It is related to metacognitive regulation in that it allows one to plan and monitor their learning to improve performance (Kallio et al., 2017; Schraw & Dennison, 1994). Kallio et al. (2017) noted that metacognitive awareness is key to developing metacognition of one's teaching.

Several inventories have been produced to measure the metacognitive awareness of students, but the Metacognitive Awareness Inventory (MAI) by Schraw and Dennison (1994) is the most widely used. A discussion of studies that used this inventory is shared later in Chapter 2, but one commonality between their findings is that students vary in their level of metacognitive awareness. Furthermore, students with higher levels of metacognitive awareness are better learners and perform better in school (Bransford et al., 1999). Balcikanli (2011) used the MAI as the basis for the Metacognitive Awareness Inventory for Teachers (MAIT) to assess instructor awareness in metacognition. Studies

support the notion that educators differ in their level of metacognitive awareness and that differences arise from experience, age, and educational level (Kallio et al., 2017; Mai, 2015).

Self-Regulated Learning Theory. Self-regulation is comprised of the following three components: (a) cognition, (b) metacognition, and (c) motivation (Zohar & Dori, 2012). Self-regulated learning theory seeks to describe the relationship between these three components (Schraw & Dennison, 1994). In this sense, motivation refers to the beliefs and attitudes that shape learning via the development of cognitive and metacognitive skills (Schraw et al., 2006). Self-regulated learning explains how individuals understand and control their learning (Zohar & Dori, 2012), implying that metacognitive regulation of learning and self-regulated learning overlap (Vermunt & Verloop, 1999). To achieve self-regulated learning, individuals must manage their strengths and weaknesses while learning (Zimmerman, 2002). The added component of motivation in self-regulated learning helps explain how metacognition allows individuals to alter their cognitive processes to achieve goals (Pintrich, 2000). One main goal of education is to help students improve self-regulated learning (Greene et al., 2011). Since metacognition is a subset of self-regulated learning, improving metacognition can also improve self-regulated learning (Bransford et al., 1999; Kallio et al., 2017; Tanner, 2012). Because of the overlapping connections between metacognition and self-regulation, the two terms are sometimes used interchangeably, even though they are not entirely synonymous (Dinsmore et al., 2008; Zohar & Barzilai, 2013).

Professional Learning Communities

A Professional Learning Community (PLC) consists of a group of educators who collaboratively work together to reflect upon their practice, develop pedagogy, and undergo professional development centered on the improvement of student learning (DuFour et al., 2016; DuFour & Eaker, 1998; Servage, 2008). Work within a PLC should be collective, and inquiry and problem-solving should apply to teaching practices (DuFour et al., 2016; Servage, 2008). PLCs promote a strong sense of community and a democratic ideal since leadership and decision-making are shared (Servage, 2008). Learning within the PLC is transformative, and educators must undergo change if a change is to occur within their organization (Servage, 2008).

Within recent years, there have been multiple definitions of what a PLC is and is not. DuFour et al. (2016) noted that the term has become so ambiguous that it is used to describe any meeting of educators or school staff, professional development, or program of study. In this study, the definition of a PLC, as described by DuFour et al. (2016), is used. Work within a true PLC encourages inquiry and problem solving and centers on collaborative work (Hord, 2009; Servage, 2008). What differentiates a PLC from other groups is that educators' work is driven by the core characteristics of a PLC (DuFour et al., 2016). The three core principles of effective PLCs are a focus on learning, a culture of collaboration, and a results orientation (DuFour et al., 2016, p. 11-12).

A Shared Vision With a Focus on Learning

The main vision of a PLC centers on student learning. The participants within a PLC embrace the idea that students are not simply taught information; they ensure that they learn to the highest standards. Fundamental to the work of a PLC is the central

mission of educators to focus on student success. Unique to the PLC is the idea that for students to learn, the organization and the educators within it must also continuously learn. Building shared knowledge among faculty gives the overall organization the foundation to initiate improvements. Within the context of a PLC, educators examine programs, policies, and practices to help every student achieve high levels of learning (DuFour et al., 2016).

A Culture of Collaboration

To support learning, educators must collaborate and take responsibility for the achievement of all students. In this sense, educators within the PLC have a collective purpose of working interdependently to achieve this common goal (DuFour et al., 2016). Many educators are prone to work independently of one another in isolation due to the inherent organization of educational systems (Hord, 2008). Contrary to this, the PLC encourages educators to work as a team and participate in team learning (DuFour et al., 2016; Senge, 2012).

A Results Orientation: Embedding Change in School Culture

PLCs are results-oriented and action-oriented communities, where members of the PLC can transform their shared vision into reality. Due to this action-orientation, members of a PLC are committed to continuous improvement and a desire to change the status quo (DuFour & Eaker, 1998). The results orientation of the work educators perform within the PLC is focused upon assessing the effectiveness of student learning and gathering and interpreting evidence of student teaching. This evidence is then used in an action cycle to inform their pedagogy, practices, and policies (DuFour et al., 2016). DuFour et al. (2016) encouraged educators within a PLC to create common formative

assessments, formal and informal assessments used during learning to assess teaching and learning with the goal to improve student achievement so that results may be examined and compared to discover personal and collective strengths and weaknesses.

An Obligation to Improve Professional Practice

Most importantly, educators have a "moral imperative to improve their individual and collective practices" (DuFour et al., 2016, p. 20). Concerning the K-12 educational system, the student population is more diverse than ever before (DuFour et al., 2016), and the racial and ethnic demographic makeup of that population is expected to change even more by the year 2050. The achievement gap in K-12 education has been well-documented (Howard, 2010), and the achievement gap between minority students and White students in postsecondary education continues to persist (Carter, 2006). DuFour et al. (2016) noted that many students are unprepared for college, and the gap remains even for postsecondary technical education. Within the particular context of two-year technical college science courses, the open-access nature of college admissions provides educational opportunities for at-risk student populations (Shannon & Smith, 2006; J. L. Smith & Vellani, 1999). Traditionally underserved and disadvantaged populations of students typically show achievement gaps in college science courses, particularly among minority students and first-generation college students (Anderson & Kim, 2006; Long et al., 2020; Lorah & Ndum, 2013; Minbiole, 2016; Packard & Babineau, 2009; R. E. Wilson & Kittleson, 2013). When educators collaborate to improve curriculum and assessments, at-risk students from these populations display improvement in their academic achievements (Burk, 2000; Kamler & Comber, 2005; Long et al., 2020; Minbiole, 2016).

Relevant Research

The implications for student use and development of metacognition are well-documented, such as its connection to academic achievement, higher-order thinking skills, critical thinking, and problem-solving (Adey & Shayer, 1993; Dang et al., 2018; Kuhn & Pearsall, 1998; Lemons et al., 2013; Zepeda et al., 2018; Zohar & Barzilai, 2013). Scholars suggest that to foster student metacognition, educators themselves must be aware of their metacognitive abilities and understand how students learn in order to help them improve (Hartman, 2001; Kallio et al., 2017; Parker & Heywood, 2013; Tanner, 2012). It may be argued that college instructors who do not utilize a metacognitive approach to teaching, or "teaching metacognitively," may vary in their metacognitive awareness, metacognitive knowledge, and self-regulation. Much of the research on metacognition has been conducted in K-12 education and preservice teachers; however, research regarding student and instructor metacognition in postsecondary education is scarce. Research also suggests that PLCs may be an environment that fosters both transformative learning and metacognition, making it an ideal form of personal and professional development for educators seeking to develop a metacognitive approach to instruction.

Teaching *for* Metacognition

Metacognition has been extensively studied over the past four decades, as it has been shown to play an important role in enhancing student learning (Pressley & Harris, 2017; Schraw & Dennison, 1994; Winne & Nesbit, 2010; Zohar & Barzilai, 2013; Zohar & Dori, 2012). Students with highly developed metacognition reap many benefits, such as the ability to self-regulate and engage in their own learning processes, require less

effort to learn, and are better able to transfer knowledge to new contexts (Pintrich, 2000; Schraw et al., 2006; Zepeda et al., 2018). Moreover, metacognition is linked to motivation, leading students to be more active learners and take ownership of their learning (Zull, 2011). Evidence suggests that high levels of student metacognition are associated with improved academic success (Dunning et al., 2003; Kruger & Dunning, 1999), and students with more developed metacognition are better able to evaluate their learning and test performance (Dang et al., 2018; Hacker et al., 2000; N. Zhao et al., 2014).

Metacognitive training and explicit instruction of metacognitive knowledge and regulation may help students become more successful learners (Cummings, 2015; Maclellan & Soden, 2012; Pelton, 2014; Pintrich, 2002; Tanner, 2012; Zohar & Barzilai, 2013; Zohar & David, 2008). Support of metacognitive development helps students develop critical thinking and problem-solving skills and aids in high levels of conceptual growth (Ben-David & Orion, 2012; Zepeda et al., 2019; Zohar & Dori, 2012). The literature supports the notion that explicitly addressing metacognition during instruction is beneficial for low-achieving and at-risk students (Kramarski et al., 2002; Pennequin et al., 2010; Zohar & David, 2008). Metacognitive classroom interventions have also been shown to enhance the learning of college students with disabilities (Mytkowicz et al., 2014). The more metacognitively perceptive a student is, the better they can utilize and adapt learning strategies to enhance performance. As students become more metacognitively aware of their thinking, they can act on this awareness and improve their learning (Bransford et al., 1999; Pintrich, 2002).

Although research regarding the explicit teaching of metacognition at the postsecondary level is scarce, there is abundant research in primary and secondary education to support the recommendation of explicit teaching of metacognition to students, especially in science education (Ben-David & Orion, 2013; Seraphin et al., 2012; Thomas & Anderson, 2014; Zohar & Dori, 2012). The use of metacognitive instructional strategies by educators should be implemented so that they can teach *for* metacognition, enabling their students to enhance performance and learning within the classroom (Pintrich, 2002). Considering the context of this action research study, relevant research regarding metacognition in science classes and of college students is examined here.

Metacognition in Science Education

The construct of metacognition has been widely studied in other fields, but research shows metacognition directly benefits students in science education (Ben-David & Orion, 2013; Seraphin et al., 2012; Thomas & Anderson, 2014; Zohar & Dori, 2012). It is associated with developing critical thinking and problem solving and deepening the understanding of the nature of science (Ben-David & Orion, 2013; Zohar & Barzilai, 2013). A growing body of research regarding metacognition in science education has strengthened the link between metacognitive learning practices and achievement in science courses at all levels of education (Adey & Shayer, 1993; Dang et al., 2018; Osterhage et al., 2019; Seraphin et al., 2012; Thomas & Anderson, 2014; N. Zhao et al., 2014).

For example, metacognition improves the effectiveness of inquiry-based science instruction (Seraphin et al., 2012). Explicit instruction, modeling, discussion, and

activities promoting metacognition help improve student understanding of scientific processes and student content knowledge (Ellis et al., 2014; Seraphin et al., 2012). Prior studies show that embedding metacognition into science instruction and inquiry-based teaching is conducive for students who struggle academically (Kramarski et al., 2002; White & Frederiksen, 1998). Studies suggest that individuals may not develop metacognitive skills independently and that one must be supported in one's development of metacognition (Leutwyler, 2009; White et al., 2009). Therefore, intentional instruction of metacognition is necessary for students to hone their metacognitive skills and strategies. Research emphatically advocates the explicit instruction of metacognition by educators, and classroom activities and instructional discourse should be embedded within lessons (Ambrose et al., 2013; Lemons et al., 2013; Pintrich, 2002; Schraw et al., 2006; Thomas & Anderson, 2014; D. Wilson & Conyers, 2013). One major caveat, however, is that educators must possess knowledge of metacognition to model it to students (Kallio et al., 2017; Parker & Heywood, 2013; Tanner, 2012) and must be supported in their professional development of metacognition in order to do so (Seraphin et al., 2012).

Metacognition in College Students

Research regarding metacognition is traditionally somewhat limited to research on children and reading (Schraw & Dennison, 1994), and fewer studies directly address the metacognition of adults. Early studies of adults have found that metacognition may predict reading skills, that adults who are poor readers lack metacognitive knowledge, and that metacognitive knowledge and monitoring improve with age (Baker, 1989; Jacobs, 1982). Moreover, earlier research demonstrated that up to 30% of the adult

population does not utilize metacognition (Chiappetta, 1976, as cited in Buoncristiani & Buoncristiani, 2012). Schraw (1994) suggested that adult learners may vary most in their metacognitive regulation, as opposed to metacognitive knowledge, and that metacognitive knowledge may develop separately from metacognitive regulation. The fact that metacognitive knowledge may be independent of metacognitive regulation means that learners may be aware of their learning skills or lack thereof, but do not possess the regulatory strategies to make appropriate adjustments (Schraw, 1994). College instructors, like educators in K-12 education, are tasked with educating students of various levels of knowledge, experience, and awareness of how they learn. Instructors may have expectations of their beginning college students to utilize critical thinking since it is a primary goal of higher education (Cummings, 2015). Some students, however, lack the metacognitive skills necessary to be successful in college and to engage in critical thinking (Cummings, 2015; Larmar & Lodge, 2014; Mangrum, 2019; Pelton, 2014). College students can be introduced to the metacognitive knowledge and skills, and research shows that these skills enhance critical thinking and academic success (Ku & Ho, 2010; Mytkowicz et al., 2014; Pelton, 2014; Rezvan et al., 2006).

Studies of metacognition in college students have yielded similar findings to that of research of primary and secondary education students. Irrespective of academic discipline, correlations between metacognition, student learning, and academic achievement have been demonstrated. Among college students, for example, high-achieving students are better predictors of test scores than low-achieving students, and low-performing students are more likely to overestimate their performance (Dang et al., 2018; Hacker et al., 2000; N. Zhao et al., 2014). Hacker et al. (2000) suggested that low-

performing students should be helped in the development of their self-regulatory skills to better prepare for examinations. N. Zhao et al. (2014) found that college chemistry students who lacked metacognitive strategies had difficulty self-assessing how well they learned course material. Ku and Ho (2010) demonstrated that students who were better critical thinkers use more metacognitive strategies than those who were less-developed critical thinkers.

More recently, Dang et al. (2018) investigated the effects of redesigning an introductory biology course to promote the development of metacognitive awareness and metacognitive skills. They incorporated reflective essays, peer discussion through collaborative group work, pre-lecture assignments, and exam review postdictions as curricular interventions. Assignments included metacognitive prompts or questions to encourage students to self-reflect and evaluate their work. They found that higher-performing students were better able to estimate exam performance, while lower-performing students tended to be overconfident in their predictions. After the metacognitive intervention, they found that lower-performing students became better at self-evaluation. Although there was no significant change in metacognitive awareness, student journal entries suggested that they benefitted from a metacognitive intervention and could better articulate plans to improve learning and academic performance (Dang et al., 2018).

The study by Doyle (2013) regarding the metacognitive awareness of adult, pre-nursing students is of particular interest to the present action research study because the present study's research participants primarily teach pre-nursing and pre-healthcare science students. Doyle (2013) found that metacognitive awareness was not associated

with GPA and final grades. The study concluded that instructors should not make assumptions about student metacognitive awareness, lest they lack fully developed metacognitive skills. Doyle (2013) suggested that instructors aid students in developing metacognitive skills through metacognitive interventions. Faculty must be developed since instructors were unaware of metacognitive processes within themselves and their students to implement such interventions successfully (Doyle, 2013). If faculty members do not understand such, "the result is a weak commitment to pedagogical strategies using reflective thinking and metacognition" (Doyle, 2013, p. 83). Doyle (2013) contended that improving faculty metacognitive development could yield significant improvements in student metacognitive awareness.

Measuring Metacognition. Many early studies relied on research subjects to self-report data (Rinehart & Platt, 1984). With the advent of the Metacognition Awareness Inventory (MAI) by Schraw and Dennison (1994) and its adoption, researchers now have an instrument to measure metacognition that has been tested for validity and reliability. The MAI is a 52-item self-report survey with items corresponding to each subcategory of metacognitive knowledge and metacognitive regulation (Schraw & Dennison, 1994). The MAI has also been adapted to test the metacognitive awareness of teachers (MAIT), discussed in a later section of Chapter 2.

The MAI has since been utilized to determine college students' metacognitive awareness (Sperling et al., 2004), finding no relation between MAI scores and scores on academic preparedness or achievement measures, such as the SAT and high school GPA. Sperling et al. (2004), however, found a positive correlation between metacognition, motivation, and strategy use among college students. In contrast, Young and Fry (2008)

discovered correlations between MAI score, student GPA, and course grades for education students enrolled in undergraduate and graduate teacher education courses. There was a significant difference based on academic experience, with graduate students scoring higher than undergraduate students (Young & Fry, 2008). Moreover, Young and Fry (2008) noted that the MAI might be used by college educators as a screening tool for students who may struggle in college coursework. Instructors may use the MAI results to specifically tailor academic interventions and advisement to individual student needs (Young & Fry, 2008).

Kallio et al. (2018) used the MAI to study students entering vocational educational programs in Finland. This study helped inform the present study because of the similarities in student populations entering technical and vocational education. The authors conducted a path analysis and found that self-evaluation was directly predicted by conditional knowledge within their group of postsecondary students, followed by declarative knowledge and procedural knowledge. They also found that planning predicted the other components of metacognitive regulation: monitoring and evaluation. By measuring planning and conditional knowledge of metacognition, they could predict the other components of metacognitive knowledge and regulation, especially self-evaluation. This held true regardless of students' age or gender within vocational programs. The authors advocated improvement in teacher education programs and professional development to help improve the readiness of both teacher and learner self-regulation (Kallio et al., 2018). The authors called for a more learner-centered pedagogical approach, noting that “supporting metacognitive awareness and self-regulative learning is a principal feature in lifelong learning” (Kallio et al., 2018, p. 113).

Teachers, then, should support students to help them improve their metacognitive awareness, targeting the development of conditional knowledge and planning as key points of leverage (Kallio et al., 2018).

Theory into Practice: Teaching for Metacognition

Metacognition is a powerful predictor of student learning (Wang et al., 1990). In science education specifically, teaching students to use and cultivate metacognition is essential for their development as future scientists (AAAS, 2011; Tanner, 2012). For example, students should know what the term *metacognition* means and be aware of its significance in learning and academic success (Martinez, 2006; Pintrich, 2002). Many authors suggest explicitly teaching metacognitive strategies to students and building a classroom culture centered around metacognitive strategies and skills for learning (AAAS, 2011; Ambrose et al., 2013; Bransford et al., 1999; Buoncristiani & Buoncristiani, 2012; Lemons et al., 2013; Schraw, 1998; Tanner, 2012; D. Wilson & Conyers, 2013). Tanner (2012) compiled a list of self-questions for use in college biology courses to promote student metacognition about learning. For example, to encourage student metacognitive regulation, students could be asked to plan before a class session by asking, "What do I already know about this topic?" (Tanner, 2012, p. 115). Evaluation during metacognitive regulation could be promoted by having students ask, "How did the ideas of today's class session relate to previous class sessions?" (Tanner, 2012, p. 115). Questions could be directly shared with students or embedded in assignments (Tanner, 2012). Other classroom activities promoting student metacognition include formative pre-assessments and retrospective post-assessments, allowing students to reflect upon their change in thinking about a topic (Buoncristiani & Buoncristiani, 2012; Tanner, 2012).

Activities after lessons or assessments, such as cognitive wrappers, may also promote metacognition by allowing students to reflect and recognize conceptual change (Dang et al., 2018; Tanner, 2012). Activities such as the Muddiest Point (Angelo & Cross, 1993, as cited in Tanner, 2012) allow students the opportunity to practice metacognitive monitoring by identifying points of confusion, while Think Aloud activities (Martinez, 2006) provide opportunities to practice metacognitive strategies out loud. Reflective journals or discussion board activities also may provide a forum by which students can monitor changes in thinking over time (K. S. Smith et al., 2007; Tanner, 2012).

Teaching With Metacognition

Within the past decade, there has been a call for a change in teaching undergraduate science courses (AAAS, 2011). This call for connecting metacognitive theory into practice has many implications for students, as discussed previously in Chapter 2. To support student metacognition and self-regulation, instructors themselves must possess metacognitive knowledge and awareness (Kallio et al., 2017; Kramarski et al., 2002; Prytula, 2012). Like their adult students, educators may vary in their metacognitive ability or may not use a metacognitive approach to teaching (Tanner, 2012; Zepeda et al., 2018). The various degrees by which instructors may be metacognitively aware in teaching imply that they may not self-regulate during instruction or improve their practice (Kallio et al., 2017; Kramarski et al., 2002).

Metacognitive Awareness of Educators

Balcikanli (2011) developed the Metacognitive Awareness Inventory for Teachers (MAIT) as a tool to be utilized within educational research. The MAIT was originally tested for validity and reliability among groups of student teachers and was the first

inventory to assess metacognitive awareness in educators (Balcikanli, 2011). Similar to the MAI developed by Schraw and Dennison (1994), the MAIT analyzed the domains of metacognitive knowledge and metacognitive regulation. The MAIT has since been used in various studies assessing metacognitive awareness in educators with varied results.

Mai (2015) studied elementary school science teachers and utilized the MAIT to measure their self-perceptions about metacognition in their teaching. One significant finding was the importance of metacognitive teaching in adapting instruction to student needs. The results of the study demonstrated differences in metacognitive awareness based on age and education. There appeared to be an interaction with age and educational level, and the study demonstrated that teachers between the ages of 20-30 had higher metacognitive awareness than teachers aged 31-40 years and 41 years and above. Overall, teachers with a bachelor's degree had higher levels of perception of metacognition than educators with a diploma (Mai, 2015). Specifically, Mai (2015) found that science teachers had strong inclinations toward metacognition. The teachers scored highest in declarative knowledge and planning, suggesting that they were aware of their strengths and weaknesses as teachers and were adept at planning and organizing their lessons (Balcikanli, 2011; Mai, 2015).

Recent research on teachers' metacognitive awareness is limited mainly to preservice teachers who were currently enrolled in college at the time of the study (Balcikanli, 2011; Mai, 2015). Research on in-service teachers is limited, and studies on the metacognitive awareness of college educators are even more limited. Kallio et al. (2017) conducted one of the few studies of in-service teachers using the MAIT. Their study targeted teachers undergoing training in vocational educational programs in

Finland. In contrast to technical and vocational education in the United States, vocational education is a compulsory continuation of secondary education in Finland. Participants in the study had varied in-service experience and were from various sectors of vocational education (Kallio et al., 2017). Kallio et al. (2017) condensed the MAIT into an 18-item questionnaire, adapting it for use in their specific educational context and use in other international contexts to be more widely used to examine metacognitive awareness in in-service teachers and to compare results with teacher trainees.

Teaching Metacognitively

Metacognition is a skill that can be improved upon and taught to others (Schraw, 1998). Metacognition develops over time, and by incorporating it into one's teaching practices, one can foster metacognition in students (Hartman, 2001; Schraw et al., 2006). To teach metacognition to students, however, one must explicitly teach it and incorporate it over time (Ambrose et al., 2013; Tanner, 2012). Most importantly, one must have a metacognitive approach to teaching and adopt metacognitive teaching practices or "teach metacognitively" (Hartman, 2001). Some strategies include explicit instruction and modeling and using metacognition when planning, monitoring, and evaluating one's teaching (Tanner, 2012; Wilson & Conyers, 2013). Ben-David and Orion (2013) remarked that metacognition is not commonly found in science classrooms despite the wealth of information about the benefits of metacognition on student learning. Duffyet al. (2009) noted the importance of metacognition in teaching, referring to educators as metacognitive professionals and stating that "instructional effectiveness, as measured by student achievement, is tied, in part, to teacher metacognition" (p. 2). The authors went so far as to call for more research regarding teacher metacognition (Duffy et al., 2009).

There are few studies of metacognition in science educators (Zohar & Barzilai, 2013), although studies suggest that teacher experience and knowledge of metacognition influence their instructional practices (Maggioni & Parkinson, 2008). Despite years of scholars promoting metacognitive teaching, Duffy et al. (2009) noted that the field is "way overdue" on conducting the necessary research (p. 13). More information is necessary to understand what influences teacher metacognition, the extent to which it is practiced, and the effects on student achievement (Duffy et al., 2009; Maggioni & Parkinson, 2008).

Theory Into Practice: Teaching With Metacognition. Learners require support and modeling in order to use metacognition. Making metacognition part of classroom discussion helps to promote language for students to talk about and reflect upon their cognition and learning (Pintrich, 2002). Despite decades of research on metacognition and its widely-agreed upon importance in learning, a gap exists between theory and practice. Aside from explicit instruction of metacognition, it may be subtly ingrained into a course and may help students become more aware of when it is appropriate to use certain metacognitive strategies (Tanner, 2012). More importantly, science instructors should be metacognitive about their teaching, just as they expect students to be metacognitive about their learning (Hartman, 2001; Tanner, 2012). In science classrooms and college classrooms, in particular, knowledge and use of metacognition are not always common (AAAS, 2011; Ben-David & Orion, 2013; Duffy et al., 2009; N. Zhao et al., 2014).

More data is needed to understand how instructors use metacognition within college classrooms and understand the effects of teaching metacognitively in science

postsecondary education. Despite the gap in knowledge and considering the wealth of information known about the benefits of metacognition, it is proposed that instructors should cultivate a metacognitive lens toward their teaching practice. To improve instruction, educators should plan, monitor, and evaluate their teaching strategies as part of their reflective practice (White et al., 2009). Duffy et al. (2009) found that this is especially true for educators in their first years of teaching, suggesting that they employ a metacognitive stance toward teaching. Tanner (2012) compiled a list of self-questions to be used by college biology instructors to promote their own metacognition about teaching. For example, to encourage one's metacognitive regulation and planning, one could ask, "What are my goals for this class session? How did I arrive at these goals?" (Tanner, 2012, p. 119). Evaluating during metacognitive regulation could be promoted by asking oneself, "How did the ideas of today's class session relate to previous class sessions? To what extent do I think students saw those connections?" (Tanner, 2012, p. 119). Reflective practices may also provide a forum by which one may monitor metacognitive teaching and thinking changes over time (Silver, 2013; Tanner, 2012).

Fostering Change Within the Professional Learning Community

Implementation of a PLC was ideal for the context of this action research study for multiple reasons. College science instructors were asked to critically self-examine and self-reflect upon their teaching strategies and develop a metacognitive stance toward teaching. The collaborative nature of the PLC provided a place for educators to incorporate change into their teaching practices (DuFour et al., 2016). The PLC is also an environment that fosters transformative learning (Servage, 2008). Finally, research

suggests that as a form of ongoing professional development, the PLC may also be an environment that fosters the development of metacognition (Prytula, 2012).

The occupation of teaching has unique attitudes, beliefs, and characteristics that affect change efforts (Evans, 2001). Some pressures and stresses that educators experience are unique to the profession and include isolation, lack of professional development, and low motivation (Chen & Miller, 1997; Evans, 2001; Johnson & Donaldson, 2007; Y. Zhao, 2013). The context of the two-year technical college in this study was unique in that many faculty were entering a second career in teaching. They had business and industry experience where they may have experienced more collaboration and different professional development requirements. This prior experience may lead to frustration as educators experience a cultural shift in their new profession (Evans, 2001). A PLC may help to lessen negative feelings since PLCs help to reduce isolation by encouraging a culture of collaboration (DuFour et al., 2016; Y. Zhao, 2013). Instructors within the PLC often experience a shift in focus that can motivate them and gain control over their professional development (DuFour et al., 2016).

Fostering Transformative Learning Within the PLC

For instructors to cope with change, they must feel psychologically supported and safe (Evans, 2001). Significant change and transformative learning are "threatening, emotionally charged, and extremely difficult" (Mezirow, 1995, as cited in Servage, 2008, p. 70). Therefore, individuals should reduce isolation and gain support from others (Evans, 2001). The PLC is a place where educators can feel psychologically safe since it reduces isolation (DuFour et al., 2016; Servage, 2008). During transformative learning, educators must be willing and able to explore and revise beliefs about their worldview,

including themselves, their students, and their practices (Servage, 2008). The collaborative setting of the PLC serves as the context and catalyst for transformation (Servage, 2008, p. 70).

Fostering Metacognition Within the PLC

Despite a lack of research on metacognitive teaching, it has been the topic of studies regarding teacher professional development (Duffy et al., 2009). Parker and Heywood (2013) suggested that training pre-service teachers in self-reflection during a professional development workshop can help them develop metacognitive awareness. Ben-David and Orion (2012) studied in-service primary school science teachers during professional development training. They collected qualitative data throughout the professional development about the integration of metacognition into science education, which included written reflections, recorded discussions, and interviews (Ben-David & Orion, 2013). They found that the teachers felt metacognition was "important and relevant" (p. 3161), but over 90% of teachers were unaware of it before professional development. Ben-David and Orion (2013) concluded that despite the significance of metacognition as a topic of research, it was invisible to science teachers and that teachers had prejudices regarding the use of metacognition in instruction (p. 3161). The research of Ben-David and Orion (2013) exposed a significant gap between theory and practice. Despite being presented with research regarding the benefits of metacognition in education, the teachers concluded that metacognition was better suited for adult and high-school students and only for high-achieving students (Ben-David & Orion, 2013). Teachers also expressed anxiety in developing student metacognition and changing teaching practices because it makes students more aware of learning and may lead

students to question instruction and threaten authority. Teachers also saw the integration of metacognition into instruction as a change, and they expressed negative feelings toward it. Finally, the teachers felt they were not capable of developing metacognitive teaching on their own (Ben-David & Orion, 2013). Despite this, they "expressed a willingness to continue their professional development toward expanding their abilities to integrate [metacognition] as an inseparable component of the science curriculum" (Ben-David & Orion, 2013, p. 3,161). Teachers cited "(1) the lack of appropriate learning materials and (2) the absence of close, supportive in classroom guidance" as barriers to integration of metacognition into science instruction (Ben-David & Orion, 2013, p. 3186). Despite research findings that Ben-David and Orion (2013) noted as "disturbing," they found that science teacher metacognition may be improved following a training program that allowed them to reflect upon their metacognitive learning and teaching practices.

While Ben-David and Orion (2013) created a metacognitive orientation learning environment for their professional development, Prytula (2012) suggested that the PLC is the ideal environment for promoting educator metacognition. Prytula (2012) studied the effects of successful PLCs on in-service teacher metacognition, suggesting that metacognitive experiences occur within the PLC and impact teacher metacognition. One significant finding was that the PLC environment nurtured the development of teacher metacognition. PLC participants had opportunities to self-reflect and analyze their thoughts. Another major finding was that the metacognitive ability of PLC leaders impacted the work performed in the PLC. Overall, the study suggested that while teachers must be supported in their development of metacognition, a PLC is a context

where learning may occur (Prytula, 2012). Moreover, educators can maximize their learning for professional growth by applying and developing metacognition (Bartz & Kritsonis, 2019).

Duffy et al. (2009) noted that metacognitive professional development should take the form of an educative model. In the educative model of professional development, teachers have control over the dynamic content and it is long-term, taking place over a period of months (Duffy et al., 2009). Educators are equal participants in learning communities, making the PLC, as described by DuFour et al. (2016), ideal for metacognitive professional development.

Summary

This study aimed to examine the effects of implementing a PLC on instructor metacognition at a two-year technical college in hopes of transforming professional practice and learning to "teach metacognitively." Much research has been conducted regarding the metacognition of primary and secondary students, dating back to the research of Flavell in the early 1970s (Flavell, 1971; Flavell et al., 1970). Research by Schraw and Dennison (1994) added to the wealth of information regarding the metacognitive awareness of K-12 students using the MAI, while the adaptation of the MAI for teachers (MAIT) spawned research of metacognition and metacognitive awareness in K-12 and pre-service teachers (Balcikanli, 2011; Kallio et al., 2017; Mai, 2015). Despite the wealth of knowledge gathered about metacognition in K-12 education over the past four decades, less is known about college students. Research regarding the metacognitive awareness of college instructors, especially at the two-year technical college level, is even rarer. This gap in the literature continues concerning PLCs.

Research shows that PLCs foster metacognition (Prytula, 2012), making the PLC the ideal context for personal and professional growth and transforming one's practice. This study aimed to generate knowledge about the use of metacognition in teaching by college science instructors and how the context of a PLC supported their professional transformation and development of metacognitive teaching strategies.

CHAPTER 3

METHODOLOGY

Metacognition, or thinking about one's thinking, includes the regulatory processes of planning, monitoring, and evaluating one's thoughts and learning processes (Flavell, 1979). Individuals utilizing metacognition possess general knowledge about cognition that drives cognitive tasks, such as declarative, procedural, and conditional knowledge (Schraw & Moshman, 1995). The relation of metacognition to student academic success, learning, and the development of thinking skills has been well-documented (Adey & Shayer, 1993; Dang et al., 2018; Kuhn & Pearsall, 1998; Zepeda et al., 2018). Students who apply metacognition can self-regulate their learning process and require less effort to learn and transfer knowledge (Pintrich, 2000; Zepeda et al., 2019). Conversely, students with less-developed metacognition do not perform as well academically (Dunning et al., 2003; Kruger & Dunning, 1999). Research suggests that metacognitive training and explicit instruction of metacognition may help bolster student academic achievement (Cummings, 2015; Maclellan & Soden, 2012; Pelton, 2014; Pintrich, 2002; Tanner, 2012; Zohar & Barzilai, 2013; Zohar & David, 2008). Explicit instruction of metacognition is also beneficial for low-achieving or at-risk students (Kramarski et al., 2002; Pennequin et al., 2010; Zohar & David, 2008). Supporting metacognitive development helps students become more motivated and positions them to take ownership of their learning, develop critical thinking and problem-solving skills, and aids in high levels of

conceptual growth (Ben-David & Orion, 2013; Zepeda et al., 2018; Zohar & Dori, 2012; Zull, 2011).

Despite much research on metacognition and its importance in learning, a gap still exists between theory and practice. Metacognition is a skill that can be taught and improved upon (Schraw, 1998), but learners need modeling and reinforcement to develop and use metacognition (Pintrich, 2002). Instructors may employ explicit instruction of metacognition to foster its development in students, but the concept may also be imperceptibly woven throughout a course. These methods may help students become more aware of the selection and use metacognitive strategies (Tanner, 2012). Duffy et al. (2009) argued that student achievement is directly linked to instructional effectiveness and teacher metacognition. To support student metacognition and self-regulation, instructors must possess metacognitive ability themselves (Kallio et al., 2017; Kramarski et al., 2002; Prytula, 2012). Like students, educators may vary in their metacognitive ability or may simply not use a metacognitive approach to teaching (Tanner, 2012; Zepeda et al., 2018). Instructors must be able to regulate their instructional practices to support student development of metacognition (Kallio et al., 2017; Kramarski & Michalsky, 2009). Teaching metacognitively involves teaching *with* metacognition to foster metacognition in students (Hartman, 2001). It is an awareness of one's metacognition to self-reflect upon teaching practices to enhance student learning (Tanner, 2012).

The present mixed-methods action research study assessed the initial state of metacognitive awareness of technical college faculty and utilized an intervention designed to help instructors learn to "teach metacognitively." The formation and

implementation of a Professional Learning Community (PLC) provided support for a group of 10 science instructors and the participant-researcher as they advanced their teaching practice and honed their use of metacognition in their instruction.

Problem of Practice

The Problem of Practice in this action research study is that instructors at a two-year technical college are experts in their given field but may not apply metacognition to their teaching, possibly limiting the instructors' ability to evaluate their pedagogical skill, instructional quality, and student engagement. Individuals may differ in their metacognition, extending to variance in how instructors utilize a metacognitive approach to thinking about teaching (Tanner, 2012; Zepeda et al., 2018). At Suburban Technical College (STC), pseudonym, instructors may enter into the teaching profession having extensive practical industry experience but little to no training in education. Moreover, professional development opportunities targeted explicitly toward faculty at STC are limited. Since campus-wide professional development for instructors is insufficient, the science instructors have looked for ways to independently enhance their professional practice. Seraphin et al. (2012) reported that faculty professional development benefits educators in learning metacognitive strategies. A PLC may be an environment that supports professional development and fosters metacognitive growth (Prytula, 2012). The formation of a PLC was novel to the context of STC. This study investigated how the development of metacognitive teaching practices by 10 technical college science instructors and the participant-researcher was impacted by the collaborative nature of discussions within a PLC.

Research Question

The following research question was investigated to address the purpose of the study and examine the Problem of Practice:

How can the implementation of a Professional Learning Community (PLC) by college science instructors support the development of metacognitive teaching?

Purpose of the Study

The purpose of this mixed-methods action research study was to explore the impact of a PLC on metacognition and teaching practice for 10 science instructors and the participant-researcher at a two-year technical college. This study sought to investigate how collaboration and discussion via the formation of a PLC affected the development of metacognitive teaching practices. While PLCs are common in K-12 education, they have been slow to move to the post-secondary level. Formal research regarding PLCs in colleges is scarce, and research in the context of two-year technical colleges is even rarer. There is also a gap in the literature regarding metacognitive awareness and the use of metacognition by instructors in post-secondary education, especially educators in technical and vocational education. Research suggests that to support student learning, instructors must understand their own metacognitive awareness and abilities to help students improve their own skills (Kallio et al., 2017).

The study assessed instructor use of metacognition before and after the intervention to examine how the PLC aided in the development of metacognitive teaching. Moreover, the participant-researcher and PLC participants explored their perceptions and their experiences within the PLC. The overarching goal of this study was

to examine the impact of the PLC on college science instructors as they incorporated metacognitive strategies into their instruction.

Action Research Design

The participant-researcher worked with 10 other science instructors to implement a PLC on a technical college campus. A mixed-methods action research methodology was utilized to study the Problem of Practice. This study employed an action research cycle since action research allows research participants to connect theory to practice, improve their craft, and foster their professional growth. The action research cycle allowed the participant-researcher and research participants to plan, implement, analyze, and reflect upon their involvement in the PLC and the development of their metacognition. Action research is an effective way for in-service educators to develop and grow professionally while customizing their professional development (Mertler, 2016). Educators in a PLC collaborate in a cyclical process of action research and inquiry with the ultimate goal of improving student learning (DuFour et al., 2008; Mertler, 2016). PLCs have a democratic nature and action orientation, making the action research methodology well-suited for the research setting. Educators benefit from the union of the PLC and action research, empowering them while providing opportunities to enhance professional practice. This synthesis gives participants the ability to tailor their professional growth to their individual context (Mertler, 2016) and may foster transformative learning (Mezirow, 1991; Servage, 2008). This approach was ideal for empowering research participants by providing a place where they could cultivate meaningful and personalized change (Efron & Ravid, 2013; Mertler, 2016).

The open-ended nature of the Problem of Practice and research questions were best suited for a mixed-methods approach to examine the various facets of the research question. This design was most appropriate for the study since quantitative and qualitative data together may offer more insight into the problem than just one type of data alone (Mertler, 2016). The mixed-methods approach allowed the participant-researcher to take advantage of the strengths of both types of data. This methodology was necessary to involve participants and use quantitative survey data to shape discussions within the PLC, engage participants, and bring about change (Creswell, 2014; Creswell & Plano Clark, 2018). Quantitative survey data were collected from the Metacognitive Awareness Inventory for Teachers (MAIT) developed by Balcikanli (2011). This instrument was the most appropriate choice for evaluating instructor metacognition before and after PLC implementation. The collection of qualitative data in the form of instructor questionnaires and semi-structured interviews provided opportunities for participants to express their opinions and for the participant-researcher to understand their perspectives (Mertler, 2016). Qualitative data was necessary to collect information to study instructor metacognition while allowing participants to self-reflect upon their professional practice.

Intervention

The formation of a PLC by 10 technical college science instructors and the participant-researcher was the intervention used in this study. Faculty and staff within the science department had asked for improved communication, better opportunities for pedagogical development, and more input about department- and campus-wide decisions. The participant-researcher proposed the formation of a PLC at a department meeting, and

the science instructors agreed to take part as a way to enhance professional practice, create a culture of collaboration and decision-making, and improve student learning. The instructors who participated in the intervention were content experts who benefitted from additional pedagogical development to improve instructional quality and student engagement. The participant-researcher and research participants engaged in a PLC to better understand and increase the use of metacognitive strategies. Instructors examined their practice to drive the development of the implementation and understanding of metacognitive teaching.

The participant-researcher and research participants formed the PLC at the beginning of a 15-week semester and met every other week to hold discussions within the PLC. A brief narrative on the nature of the PLC meetings is described in Chapter 4. The quantitative results of the Metacognitive Awareness Inventory for Teachers (MAIT) were used to guide initial discussion topics within the PLC. This emergent design allowed all participants to collaborate in the research process and data analysis and alter discussion within the PLC to tailor it to each instructor's needs. At the conclusion of the study, the MAIT and questionnaires were administered a second time, and a final self-reflection was performed to assess the effects of the PLC on instructor metacognition. Instructors exhibiting the least and the greatest metacognitive gains were interviewed to provide further insight into the effects of the PLC.

Research Context and Setting

Suburban Technical College (STC) is a two-year technical college located in a large metropolitan suburb in the southeastern United States. It serves more than 21,000 students per year in college credit courses, adult education, and continuing education. Of

those students, approximately 11,100 students earn college credit, and over 1,500 are dual-enrollment students. STC is considered an "open enrollment" institution requiring only a high school diploma or equivalent for admission. ACCUPLACER® scores determine placement in degree-level or learning support courses. The student population is incredibly diverse in age, ethnicity, college experience, and socioeconomic status. Approximately 59.5% of students are female (40.5% male), and 67.9% of students are members of a minority group. Students have varying degrees of educational experience, with 39.6% of students having completed one to three years of post-secondary education before attending STC, and 6.8% of students hold a bachelor's degree or higher. The college's graduation rate is 76.3%, while the college-wide retention rate is 66.6%. The average retention rate among science courses is approximately 70-80% and as low as 50-60% in Anatomy & Physiology I. Within the context of science courses at STC, as of the 2018–2019 academic year, there were approximately 6,700 students enrolled in basic sciences (biology, chemistry, and physics). Of those students, nearly 5,400 students were enrolled in biology.

Formal professional development opportunities are provided by STC twice per year but typically focus on topics that are common to all employees, such as budget training, new technologies, and employee enrichment. New faculty orientation usually focuses on institutional processes and policies and some basic classroom management techniques. Teaching experience is preferred but not required for full-time or part-time employment as an instructor. Any professional development for faculty is typically led by instructors who volunteer to do so. The science faculty have carried out internal professional development in the form of book studies to learn more about teaching

methodologies. These book studies, however, are short-lived as the group finishes the book and discussions cease.

Additionally, in the year before the PLC initiation by science instructors, there was a push among college faculty to revamp adjunct faculty training and to implement a Center for Teaching Excellence for both full- and part-time faculty. At the time of the study, the Center for Teaching Excellence had not come to fruition; its website and resources were still undeveloped, and there was no dedicated space or training planned. An informal survey regarding STC faculty requests for a Center for Teaching Excellence revealed a need for professional development on teaching strategies and less desire for training on mandatory technology and institutional processes. Moreover, within the science department, faculty reported feelings of working in "silos" and lacking a voice when it comes to decision-making.

Research Participants

The 10 participants in this study were full-time biology, chemistry, or physics instructors at STC. The participants were chosen through a purposeful sampling of instructors at STC who met the criteria of having prior work experience outside higher education. This sample happened to include all full-time science faculty at STC, although one instructor opted-out of participating in the study due to scheduling conflicts. There are eight full-time biology instructors and 20 adjunct biology instructors who teach upwards of 140 different course sections each semester. There are two full-time chemistry instructors, three chemistry adjunct instructors, one full-time physics instructor, and two physics adjunct instructors. Generally, science laboratory classes have a student-to-instructor ratio of 24:1 or 32:1, while the ratio in lecture courses ranges from

30:1 to 64:1. Full-time faculty are required to teach seven courses each semester each fall and spring semester and three in the summer, while adjunct faculty typically teach between two and four courses each semester.

The participants had varied educational backgrounds, but all hold a Master's Degree or higher in biology, chemistry, physics, or another related field. Pseudonyms are used throughout the study to protect the identity of each participant. Of the 10 instructors participating, five have prior experience in a medical setting in chiropractic or dentistry. These instructors previously practiced in their respective fields. The remaining instructors hold a Master's of Science (M.S.) or Doctor of Philosophy (Ph.D.) in biology, chemistry, or physics and have previous experience in their specific fields of science. One instructor holds both a Master's of Science as well as an Educational Specialist (Ed.S.) degree. Table 3.1 summarizes the pertinent characteristics of each research participant.

The research participants were chosen since they were content experts in their fields of science and medicine but may have utilized some degree of metacognition as students or in their previous careers. While scientists are prone to use metacognition, this does not automatically transfer to teaching (Tanner, 2012).

Research Methods

Multiple data sources contributed to the study to thoroughly investigate and answer the research question with the research participants. The participant-researcher and research participants used the MAIT as a pre- and post-test to measure instructor metacognition before and after the intervention. Instructor questionnaires were deployed at the beginning and end of the study to evaluate the perception of the PLC and teaching.

Table 3.1 *Demographic Characteristics and Educational Background of Participants*

Demographic Data		***n* Responses**	**Percent**
Gender	Female	6	60.0%
	Male	4	40.0%
Age	25 – 29 years	2	20.0%
	30 – 39 years	2	20.0%
	40 – 49 years	3	30.0%
	50 – 59 years	1	10.0%
	60 – 69 years	2	20.0%
Race / Ethnicity	Asian	1	10.0%
	White	9	90.0%
Highest Degree Obtained	Master's Degree (M.S.)	6	60.0%
	Educational Specialist (Ed.S.)	1	10.0%
	Doctor of Chiropractic (D.C.)	2	20.0%
	Doctor of Philosophy (Ph.D.)	1	10.0%
Industry / Research Experience	1 – 5 years	5	50.0%
	6 – 10 years	3	30.0%
	11 – 15 years	0	0.0%
	15 – 20 years	1	10.0%
	> 20 years	2	20.0%
Teaching Experience	1 – 5 years	5	50.0%
	6 – 10 years	1	10.0%
	11 – 15 years	1	10.0%
	15 – 20 years	2	20.0%
	> 20 years	1	10.0%

The research-participant also used semi-structured interviews to gain insight into the experiences of instructors who showed the least and the most metacognitive gain.

Metacognitive Awareness Inventory for Teachers

The Metacognitive Awareness Inventory for Teachers was developed as a tool to be utilized within educational research (Balcikanli, 2011). Permission to use the MAIT for this study was granted by Dr. Cem Balcikanli, creator of the instrument (Appendix G). The MAIT was tested for validity and reliability among groups of student teachers and was the first inventory developed to assess metacognitive awareness in educators (Balcikanli, 2011). The MAIT has been used in various studies assessing metacognitive awareness in educators. For a more in-depth discussion of the MAIT, its development, and its use, see Chapter 2.

The MAIT (Appendix A) is a 24-item Likert-style survey that may be used to analyze the domains of metacognitive knowledge and metacognitive regulation. The MAIT includes questions for each subfactor of metacognitive knowledge: declarative knowledge, procedural knowledge, and conditional knowledge (Balcikanli, 2011). Declarative knowledge is the knowledge of cognitive strategies (Pintrich, 2002). For example, the MAIT assesses declarative knowledge by asking instructors, "I pace myself while I am teaching in order to have enough time" (Balcikanli, 2011, p. 1331). Procedural knowledge is the effective use of metacognitive strategies (Zohar & Dori, 2012). The question, "I ask myself how well I have accomplished my teaching goals once I am finished" (Balcikanli, 2011, p. 1331), assesses procedural knowledge. Conditional knowledge is knowing when and why to use one's declarative and procedural knowledge (Zohar & Dori, 2012). It is evaluated with the question, "I ask myself if I could have used

different techniques after each teaching experience" (Balcikanli, 2011, p. 1331). Likewise, the MAIT has a set of questions for each component of metacognitive regulation, including planning, monitoring, and evaluating (Balcikanli, 2011). These processes help control one's thinking (Schraw & Moshman, 1995). Planning is the act of selecting appropriate strategies, goal-setting, and time management (Zohar & Dori, 2012). On the MAIT, the question "I use different teaching techniques depending on the situation" (Balcikanli, 2011, p. 1331) reflects planning. Monitoring is the ability to self-assess strategy use (Schraw & Dennison, 1994) and identify strengths and weaknesses (Schraw & Moshman, 1995). To assess monitoring, the MAIT asks, "I check regularly to what extent my students comprehend the topic while I am teaching" (Balcikanli, 2011, p. 1331). Evaluation is one's judgment of one's goals and strategies and encompasses the reevaluation of goals after completing a task (Schraw & Moshman, 1995). This is reflected in the question, "I ask myself if I have considered all possible techniques after teaching a point" (Balcikanli, 2011, p. 1331).

The MAIT instrument was ideal for the context of this study since it has been accepted as a measurement of metacognition in educators. It allowed PLC participants to evaluate their use of declarative knowledge, procedural knowledge, conditional knowledge, planning, monitoring, and evaluating (Balcikanli, 2011). The MAIT was administered to participants at the beginning of the intervention and again after the study.

Instructor Questionnaires

The second method of data collection was instructor questionnaires (Appendix B). Questionnaires consisted of eight open-ended questions that collected qualitative data. The participant-researcher administered questionnaires to each of the research

participants. The questions were designed to give further insight into the change experienced by PLC participants to glean information on the experience as it influenced their metacognition. Questions investigated instructor knowledge and perceptions of PLCs and their anticipations. Question 1 of the pre- and post-questionnaires asked, “What do you understand to be the definition of a Professional Learning Community (PLC)?” Question 2 of both questionnaires asked instructors, “What perceptions do you currently have about PLCs?” The anticipation of learning was the topic of Question 3 on the pre-questionnaire, while Question 3 of the post-questionnaire asked, “What did you learn by taking part in the PLC?” Instructors were asked in the pre-questionnaire, “Have you ever participated in a PLC before? If so, what was your experience like?” and were asked to summarize their experience on the post-questionnaire in Question 4. The anticipation of change was asked in Question 5 of the pre-questionnaire: “Do you anticipate that the PLC will change you in any way? How or why?” while the post-questionnaire asked, “Has the PLC changed you in any way? How or why?” Question 6 asked about instructional strategies, with anticipation of change as the question in the pre-questionnaire and reflection of change in the post-questionnaire. Finally, Questions 7 and 8 were the same between the pre- and post-questionnaires. Question 7 asked, “How much time do you spend planning lessons before class? How is this time divided between designing the lesson and collaborating with colleagues about that lesson?” Question 8 was similar and asked, “How much time do you spend reflecting on lessons after class? How is this time divided between revising the lesson and collaborating with colleagues about that lesson?”

Semi-Structured Interviews

The final data collection method was semi-structured interviews of participants who showed the least and the greatest metacognitive gains according to scores on the MAIT. In the semi-structured interviews, the participant-researcher asked base questions on the interview guide and asked multiple, optional questions as follow-up based on participant feedback. This format allowed the participant-researcher to uncover the reasoning behind participants' answers. The six guiding interview questions listed in Appendix C addressed the experiences of instructors within the PLC. The interview guide was developed by framing the interview questions around studies of teacher metacognition (Mai, 2015; Prytula, 2012; Tanner, 2012). Additional questions came from responses to the individual instructor questionnaires.

Procedure

The intervention was divided into three phases for data collection and PLC implementation. Data were collected sequentially to develop PLC discussions and to work with participants so that the research was meaningful and personalized to their context. Figure 3.1 depicts the overall research design, data collection, and analysis process.

Phase I: Weeks 1-2

Phase I took place during Weeks 1 and 2 of the semester and consisted of planning and initiating the PLC. During Week 1, prior to PLC formation, instructors completed the MAIT (Balcikanli, 2011) to explore their initial use of metacognition in teaching. Within the same time period, instructors took the pre-questionnaire. Afterward, the participant-researcher introduced the PLC model to the participants, as described by

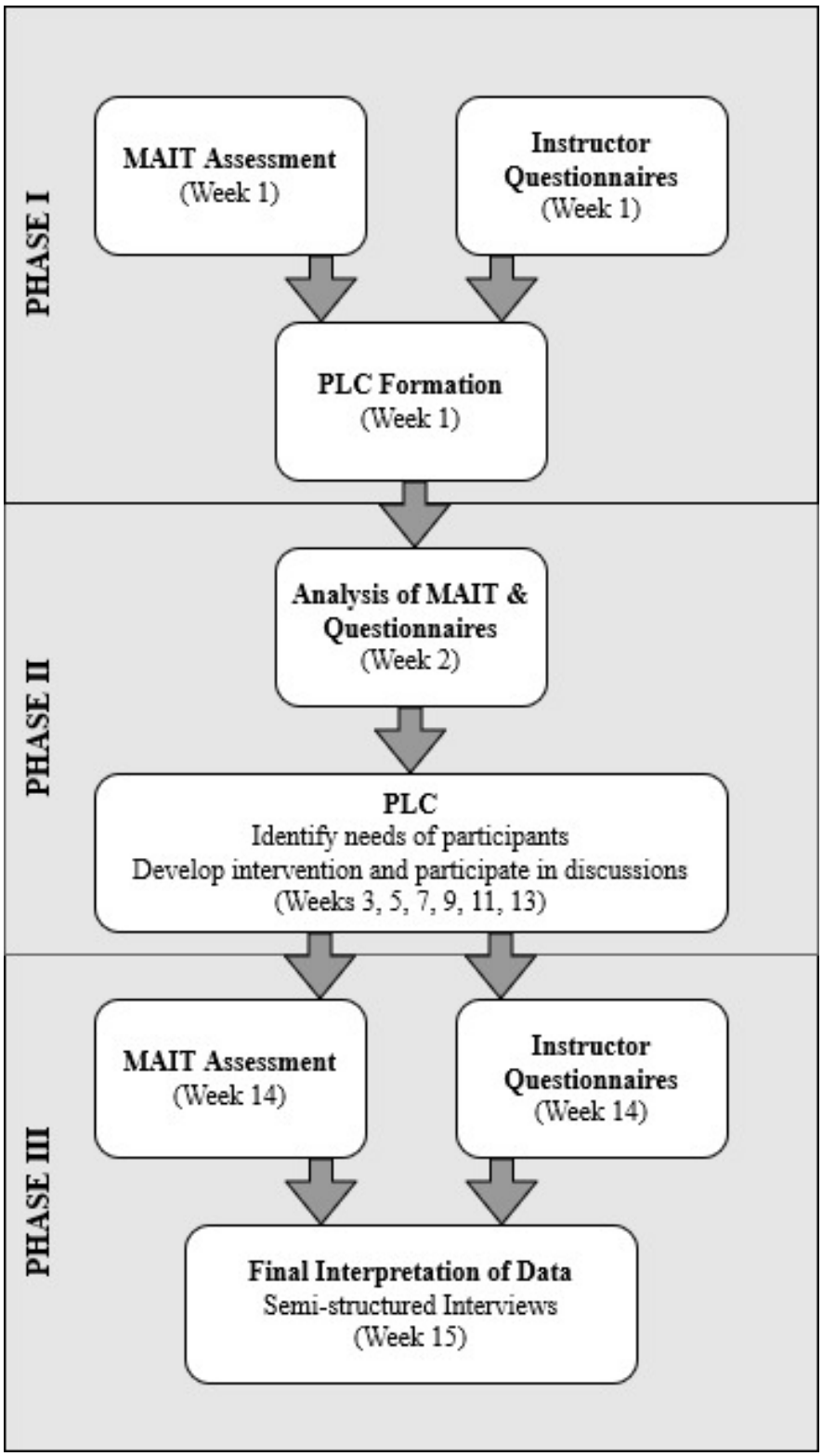


Figure 3.1 Overview of research design, data collection, & analysis.

DuFour, DuFour, Eaker, Many, and Mattos (2016). The MAIT results and instructor insights from the pre-questionnaire served as a baseline for comparison to assess change in metacognitive teaching.

Phase II: Weeks 3-13

Data from Phase I was used as a starting point for discussion within the PLC, and the research participants and participant-researcher analyzed data together to guide initial discussions. Simultaneous discussion and analysis of data from Phase I aided in understanding metacognitive teaching and initiated the action research cycle (Merriam & Tisdell, 2016). In Phase II, the participants and participant-researcher worked together to develop the PLC during Weeks 3-13 of the research study. Instructors met every other week to discuss topics determined by the previous meeting to impact student success and each instructor's professional practice directly. The PLC utilized the model described by DuFour et al. (2016), collaborating and embracing the three core principles of a focus on learning, a culture of collaboration, and a results-orientation (pp. 11-12).

Phase III: Weeks 14-15

Phase III of the study concluded the intervention as instructors reassessed their metacognition in teaching and their perceptions of the PLC. The final administration of the MAIT and instructor questionnaires was in week 14 of the semester, which helped instructors to assess the perceived change in their metacognitive teaching during the PLC intervention. During week 15, instructors showing the greatest metacognitive gain and the least metacognitive gain on the MAIT were interviewed using semi-structured interviews. Data collected during this phase served to answer the research question.

Data Analysis

The participant-researcher followed the quantitative and qualitative data analysis methods described by Mertler (2016) and Parsons and Brown (2002) for this action research study. The mixed-methods approach allowed the participant-researcher to collect quantitative data from the MAIT and qualitative data from the instructor questionnaires and semi-structured interviews. Data collection from various sources and times allowed for the triangulation of data, ensuring that results had internal validity and credibility (Creswell & Miller, 2000; Merriam & Tisdell, 2016). Multiple methods of data analysis were used to ensure the credibility, consistency, and transferability of findings. In mixed-methods action research, particularly the qualitative portion, it is of utmost importance that the findings reflect the reality of the research context and participants (Merriam & Tisdell, 2016).

Quantitative Data Analysis

Analysis of the quantitative data collected from the MAIT results was performed using descriptive statistics. Descriptive statistics are simple mathematical calculations to summarize and organize numerical data (Mertler, 2016). This method of analysis is useful to describe quantitative data and to identify trends in data (Mertler, 2016). On the MAIT, individuals rated themselves on a Likert-style scale from 1 to 5. The six subsets of metacognition had four questions representing each construct. Data from each instructor's MAIT were transcribed into a Microsoft Excel spreadsheet to organize, track, and perform statistical analysis. Data compiled from the MAIT in Phases I and III were shared with research participants, and member checking was used to ensure the trustworthiness of data. These scores were used to calculate an average score for each

individual from each subset of metacognitive knowledge and metacognitive regulation, as described on the MAIT instrument (Appendix A). Average individual scores from the MAIT in Phase I were compared with the MAIT scores in Phase III to evaluate overall growth.

Qualitative Data Analysis

Instructor questionnaires and semi-structured interviews were analyzed using qualitative data analysis methods. The qualitative data analysis process involves a process of inductive analysis (Mertler, 2016). Parsons and Brown (2002) described a three-step process of organization, description, and interpretation. In this process, the researcher must first reduce the amount of data by identifying and organizing the data into themes. The first step of organization was achieved by applying a coding scheme, where similar types of data are grouped into similar types of information (Mertler, 2016). As patterns emerged, each category was noted, and the qualitative data were grouped and coded accordingly. Next, the main features of each category were described as a result of the coding scheme and connected to the research question. In the interpretation phase, the coded categories are evaluated for events, behaviors, or observations that form relationships, are similar, or are contradictory (Mertler, 2016).

After each administration of the questionnaire, instructor questionnaire data were analyzed and shared with PLC participants to guide initial discussions. The qualitative portion of the questionnaire was coded and analyzed for themes. Instructors showing the least and the greatest metacognitive gains according to their final self-assessment on the MAIT were selected for a semi-structured interview. Interview data were also coded and analyzed for themes and subsequently member-checked. The compilation of data

collected, data analysis, and conclusions of the participants within the PLC was shared with a party outside of the research setting for peer review.

The participant-researcher worked collaboratively with the PLC participants to collect and analyze data throughout the research process. As part of the action plan, the participant-researcher and researcher participant used member checking and collaboration to make sure that the participants' voices were represented and that the data were reliable and consistent (Creswell & Miller, 2000; Merriam & Tisdell, 2016). This method ensured that the data interpretation was consistent with the meaning the research participants intended to convey (Merriam & Tisdell, 2016). The data analysis methods outlined here allowed for the analysis of the outcome of action research and to study "the process of change itself" (Merriam & Tisdell, 2016, p. 258).

Reflection and Action Plan

The action research process is iterative and consists of four phases: a planning stage, acting stage, developing stage, and reflecting stage (Mertler, 2016). The participant-researcher initiated the action research spiral by beginning the planning stage. The data collected and analyzed during the acting stage was shared with research participants to ensure that their experiences were accurately reported. Reflection with participants was a critical aspect of developing the action research plan. For the PLC to be meaningful within the context of the study, the individual PLC members had to be involved in forming the next stages of action research. According to Mertler (2016), this is vital for continuing the action research cycle.

Summary

The methodology of this action research study was discussed in Chapter Three. It discussed the mixed-methods action research design, research methods, procedure, data collection, and data analysis. The participant-researcher used a triangulation mixed-methods design such that both quantitative and qualitative data were weighted equally (Mertler, 2016). Data collection and analysis of both data types occurred simultaneously, resulting in a convergent analysis (Mertler, 2016). This study took place at a Technical College, where 10 science instructors worked together to implement a PLC. Data collected at the beginning of the semester via the MAIT and instructor questionnaires were compared to data collected at the end of the semester using the same instruments. The instructors showing the least and the greatest metacognitive gains were selected for a semi-structured interview at the conclusion of the study. The participant-researcher took part in the PLC and data collection and analyzed the quantitative and qualitative data before sharing it with participants.

CHAPTER 4

PRESENTATION AND ANALYSIS OF DATA

The present mixed-methods action research study sought to evaluate the preliminary level of metacognitive awareness of technical college faculty and utilized an intervention designed to help instructors learn to "teach metacognitively." Individuals differ in their metacognitive ability, and instructors may vary in their metacognitive stance to teaching (Tanner, 2012; Zepeda et al., 2018). The Problem of Practice in this action research study is that instructors at a two-year technical college are experts in their given field but may not apply metacognition to their teaching. Research suggests that the context of a Professional Learning Community (PLC), in which instructors have dynamic control over their professional development, may foster metacognitive growth (Duffy et al., 2009; Prytula, 2012; Seraphin et al., 2012). The PLC is also an environment that fosters metacognitive development and transformative learning (Prytula, 2012; Servage, 2008). The formation and implementation of a PLC provided support for a group of 10 science instructors and the participant-researcher as they advanced their teaching and honed their use of metacognition in their professional practice. Data collected before and after the intervention helped answer the research question, "How can the implementation of a Professional Learning Community (PLC) by college science instructors support the development of metacognitive teaching?" The overall purpose of this study was to explore the effect of a PLC on metacognition and teaching practice for 10 science instructors and the participant-researcher at a two-year technical college.

Findings of the Study

Over a 15-week semester, 10 Suburban Technical College (STC) science instructors and the participant-researcher implemented and engaged in a PLC. The participant-researcher and research participants were content experts who benefitted from the additional professional development to improve their professional practice; they took part in a PLC to better understand their metacognitive use of teaching strategies. The PLC was formed at the beginning of the semester and met every other week. Due to the COVID-19 pandemic, all PLC meetings were held in a virtual format. The Metacognitive Awareness Inventory for Teachers (MAIT) and instructor questionnaire were administered during Week 1 of the semester and again after the intervention during Week 14. Quantitative data from the MAIT survey complemented qualitative data collected from instructor questionnaires to guide the initial discussion topics within the PLC. At the conclusion of the study, the MAIT and questionnaires were administered a second time. Instructors exhibiting the least and the greatest metacognitive gains were interviewed to provide further insight into the effects of the PLC.

The PLC Intervention

At the initial PLC meeting during Week 3 of the semester, the participant-researcher shared the purpose of a PLC and the main elements of a PLC with instructors. The participant-researcher presented the results of the MAIT to the PLC participants, opening a discussion on the questions that had the highest and lowest scores. The participant-researcher and the PLC participants then used the characteristics of the PLC and what they learned from their MAIT results to brainstorm their vision for the PLC, as well as the “collective commitments” as described by Dufour et al. (2016). In this initial

meeting, the PLC participants agreed to limit the meetings to just 30 minutes, and Instructor C volunteered to keep track of time and check the group when it got off-task.

The participant-researcher presented the general findings of the MAIT pre-survey and questionnaires to the participants in the first PLC meeting; however, in the subsequent PLC meetings, the discussion topics were selected and led by the PLC participants. This was purposefully planned so that the PLC itself was the intervention and the variable introduced to evaluate the effects on metacognition, not the explicit discussion of metacognition nor the MAIT itself. Discussion of the metacognitive statements on the MAIT were addressed in the initial meeting, but subsequent meetings moved forward with those ideas in mind.

The PLC meetings took shape and morphed during the course of the semester. Over time, the research participants became more comfortable with suggesting and even leading PLC meetings. The topic for each meeting was determined beforehand, based upon instructor suggestions or requests. In one PLC meeting, for example, Instructor D led a discussion where each instructor demonstrated an online teaching technique or piece of technology they used in lecture or lab class. As a result, some instructors began attending other instructors' classes to learn additional techniques. The participant-researcher began a project to record other instructors teaching online to share videos of best practices in instruction.

In another meeting, Instructor A and Instructor J brought forth student issues regarding online testing. It led to a discussion about the departmental testing policies and equity. This discussion resulted in the formation of committees to review student problems with the learning management system and academic integrity. Another meeting

centered around Instructor B and Instructor I discussing the low course pass rates in some science courses. As a result, a student survey was administered to students in those courses to better understand their reason for withdrawing, or choosing not to withdraw, from their courses. Toward the end of the semester, the participant-researcher presented data collected from student surveys to have the PLC participants evaluate and make suggestions. Instructor L took the data for further evaluation and presented their findings at the final meeting. Because of this analysis by the PLC participants, Instructor L was able to find evidence to suggest specific study skills, not the amount of time spent studying, were vital to student success in science courses.

Results of the Metacognitive Awareness Inventory for Teachers (MAIT)

Quantitative data collected during the study was gathered via the MAIT. This instrument was administered to PLC participants as a pre- and post-survey at the beginning and end of the 15-week semester. The MAIT consisted of 24 items that collected data on the individual subsets of metacognitive knowledge and metacognitive regulation. Questions assessing metacognitive knowledge covered the domains of declarative knowledge, procedural knowledge, and conditional knowledge. Questions that measured metacognitive regulation pertained to the domains of planning, monitoring, and evaluating.

The MAIT is scored on a Likert-style scale from 1 (lowest) to 5 (highest) (Appendix A). A score of 3 was considered to be neutral. A score of 1 was “strongly disagree,” and 2 was “disagree,” while a score of 4 was “agree,” and 5 was “strongly agree.” The raw data for instructor answers on the MAIT are compiled in Appendix D. The participant-researcher analyzed pre- and post- MAIT survey scores using descriptive

statistics. Data were compiled in Microsoft Excel for data analysis. The participant-researcher calculated the overall average for each question on the MAIT (Table 4.1), as well as the average score for the domains of metacognitive knowledge (Table 4.2) and metacognitive regulation (Table 4.3). Table 4.1 shows the overall pre- and post-survey averages for each question, as well as the overall change in average score for all instructors. On the MAIT, Questions 1-12 assessed metacognitive knowledge. Questions 1-4 belonged to the declarative knowledge domain, Questions 5-8 belonged to procedural knowledge, and Questions 9-12 belonged to conditional knowledge. Metacognitive regulation was assessed by Questions 13-24. Questions 13-16 belonged to planning, Questions 17-20 belonged to monitoring, and Questions 21-14 belonged to the evaluation domain. Domain scores were calculated from the sum of the four questions asking about each domain, with a maximum score of 20 points. According to the MAIT scoring guide (Appendix A), the closer the score is to 20 points, the more an individual uses that component of metacognition. The subset and domain averages were calculated from the average score of a particular subset or domain for all instructors.

On the pre-survey MAIT, the average score for metacognitive knowledge was 15.17 points, while metacognitive regulation had an overall average of 15.13 points. The post-survey MAIT revealed the average score of metacognitive knowledge was 16.47 points, with an increase of +1.30 points after the intervention. The average score for metacognitive regulation on the post-survey MAIT was 15.53 points, increasing +0.40 points compared to the pre-survey results.

Table 4.1 *Average MAIT Results per Question*

	Question	Pre-Survey	Post-Survey	Change
Declarative Knowledge	1. I am aware of the strengths and weaknesses in my teaching.	4.00	4.30	+0.30
	2. I try to use teaching techniques that worked in the past.	4.30	4.70	+0.40
	3. I use my strengths to compensate for my weaknesses in my teaching.	3.90	4.50	+0.60
	4. I pace myself while I am teaching in order to have enough time.	3.90	4.10	+0.20
Procedural Knowledge	5. I ask myself periodically if I meet my teaching goals while I am teaching.	3.30	3.90	+0.60
	6. I ask myself how well I have accomplished my teaching goals once I am finished.	3.60	3.90	+0.30
	7. I know what skills are most important in order to be a good teacher.	3.40	3.80	+0.40
	8. I have a specific reason for choosing each teaching technique I use in class.	3.80	4.10	+0.30
Conditional Knowledge	9. I can motivate myself to teach when I really need to teach.	4.40	4.60	+0.20
	10. I set my specific teaching goals before I start teaching.	3.50	3.60	+0.10
	11. I find myself assessing how useful my teaching techniques are while I am teaching.	3.60	3.80	+0.20
	12. I ask myself if I could have used different techniques after each teaching experience.	3.80	4.10	+0.30
Planning	13. I have control over how well I teach.	4.00	4.30	+0.30
	14. I am aware of what teaching techniques I use while I am teaching.	3.50	4.00	+0.50
	15. I use different teaching techniques depending on the situation.	4.20	4.30	+0.10
	16. I ask myself questions about the teaching materials I am going to use.	3.50	3.60	+0.10
Monitoring	17. I check regularly to what extent my students comprehend the topic while I am teaching.	3.80	3.80	0.00
	18. After teaching a point, I ask myself if I'd teach it more effectively next time.	3.80	3.70	-0.10
	19. I know what I am expected to teach.	4.80	4.80	0.00
	20. I use helpful teaching techniques automatically.	4.20	4.00	-0.20
Evaluation	21. I know when each teaching technique I use will be most effective.	3.20	3.10	-0.10
	22. I organize my time to best accomplish my teaching goals.	3.70	3.70	0.00
	23. I ask myself questions about how well I am doing while I am teaching.	3.90	4.30	+0.40
	24. I ask myself if I have considered all possible techniques after teaching a point.	2.80	3.00	+0.20

Within each subset, there was variation between the domains. For the subset of metacognitive knowledge on the pre-survey (Table 4.2), procedural knowledge had the lowest average (14.10 points) when compared to declarative knowledge (16.10 points) and conditional knowledge (15.30 points). In looking at the overall average for each question shown in Table 4.1, instructors scored the lowest on the pre-survey questions about procedural knowledge, especially Question 5 ("I ask myself periodically if I meet my teaching goals while I am teaching") with an overall average of 3.30 points. Instructors scored the highest in metacognitive knowledge, specifically conditional knowledge, on Question 9 ("I can motivate myself to teach when I really need to teach") with an overall average of 4.40 points. The post-survey MAIT results (Table 4.2) revealed an increase of +1.30 points in metacognitive knowledge scores (16.47 points). Each domain of metacognitive knowledge increased, with an overall positive increase of +1.50 points for declarative knowledge (17.60 points), +1.60 points for procedural knowledge (15.70 points), and +0.80 points for conditional knowledge (16.10 points).

At the completion of the study, the most substantial gains were in declarative knowledge and procedural knowledge. Instructors had the greatest overall change on

Table 4.2 *Average MAIT Results for Metacognitive Knowledge and Its Domains*

Subset	**Pre-Survey Subset Average**	**Post-Survey Subset Average**	**Change**	**Domain**	**Pre-Survey Domain Average**	**Post-Survey Domain Average**	**Change**
Metacognitive Knowledge	15.17	16.47	+1.30	**Declarative Knowledge**	16.10	17.60	+1.50
				Procedural Knowledge	14.10	15.70	+1.60
				Conditional Knowledge	15.30	16.10	+0.80

Question 3 (“I use my strengths to compensate for my weaknesses in my teaching”) and Question 5 with a net gain of +0.60 points on each question (Table 4.1). Likewise, the average score on Question 1 (“I am aware of the strengths and weaknesses in my teaching”) and Question 2 (“I try to use teaching techniques that worked in the past”) increased by +0.30 points and +0.40 points, respectively. There was a slight increase in score (+0.20 points) on Question 4 (“I pace myself while I am teaching in order to have enough time”); however, individual instructor responses remained relatively constant, with the majority of instructors answering the same on the post-survey MAIT as on the pre-survey MAIT. Concerning the survey items for procedural knowledge, each question's average score increased (Table 4.1). The average score on Question 8 (“I have a specific reason for choosing each teaching technique I use in class”), however, increased just +0.30 points. In regard to conditional knowledge, there was an increase in the average score on Question 9 with an increase of +0.20 points and Question 12 (“I ask myself if I could have used different techniques after each teaching experience”) with a change of +0.30 points. Scores on Question 11 (“I find myself assessing how useful my teaching techniques are while I am teaching”) increased slightly; still, the average score of Question 10 (“I set my specific teaching goals before I start teaching) changed the least out of all questions concerning metacognitive knowledge (+0.10 points). This lack of change was primarily due to Instructor D's response, who was the only instructor who rated themselves lower on the post-survey MAIT than on the pre-survey.

Within the subset of metacognitive regulation on the pre-survey MAIT, shown in Table 4.3, instructors scored the highest on monitoring with an overall domain average of 16.60 points, followed by an average of 15.20 points for planning. However, the domain

Table 4.3 *Average MAIT Results for Metacognitive Regulation and Its Domains*

Subset	Pre-Survey Subset Average	Post-Survey Subset Average	Change	Domain	Pre-Survey Domain Average	Post-Survey Domain Average	Change
Metacognitive Regulation	15.13	15.53	+0.40	**Planning**	15.20	16.20	+1.00
				Monitoring	16.60	16.30	-0.30
				Evaluation	13.60	14.10	+0.50

average for evaluation had the lowest average of all domains with a mean score of 13.60 points. Participants scored the highest on Question 19 (”I know what I am expected to teach”) under the domain of monitoring with an average score of 4.80 points. Conversely, two of the lowest average scores on the pre-survey MAIT belonged to the domain of evaluation. Question 21 (“I know when each teaching technique I use will be most effective”) had an average score of 3.20 points. The lowest score on the pre-survey MAIT was 2.80 points on Question 24 (“I ask myself if I have considered all possible techniques after teaching a point”).

The post-survey MAIT results for metacognitive regulation (Table 4.3) showed an increase of +0.40 points in metacognitive regulation scores (15.53 points). The planning and evaluation domains increased with an overall change of +1.00 points and +0.50 points, respectively. The domain of monitoring, however, decreased by -0.30 points. The average metacognitive regulation scores' overall gains were not as substantial as average scores for metacognitive knowledge. As shown in Table 4.1, the scores on Questions 15, 16, 17, 19, 22, and 24 remained relatively constant in looking at the average score per question. The greatest score increases related to planning were on Question 13 (“I have

control over how well I teach") with an overall change of +0.30 points and Question 14 ("I am aware of what teaching techniques I use while I am teaching") with an overall change of +0.50 points. All questions on the MAIT concerning monitoring either stayed the same or had a decrease in their average score, with the largest decreases on Question 18 ("After teaching a point, I ask myself if I'd teach it more effectively next time"), which decreased by -0.10 points, and Question 20 ("I use helpful teaching techniques automatically"), which decreased by -0.20 points. Under the evaluation domain, Question 21 also decreased by -0.10 points, while Question 23 ("I ask myself questions about how well I am doing while I am teaching") increased by +0.40 points. Like the pre-survey MAIT, Questions 21 and 24 from the evaluation domain had the lowest scores on the post-survey MAIT; however, while the average score for Question 21 decreased by -0.10 points, the score for Question 24 increased by +0.20 points.

MAIT Results by Instructor

Average scores on the pre-survey MAIT and the metacognitive domains for individual instructors are presented in Table 4.4. The domain totals for each set of questions are presented, each out a maximum total of 20 points. The overall average for all MAIT questions is shown per instructor, out of a maximum average of five points. The highest overall scores on the pre-survey MAIT belonged to Instructor J (4.29 points) and Instructors H and K (4.17 points). The lowest overall scores were from Instructor B (3.08 points) and Instructor D (3.29 points). Instructor J scored the highest out of all of the other instructors for the domains of declarative knowledge (18 points) and conditional knowledge (18 points), while Instructor K scored the highest for procedural knowledge

Table 4.4 *Overall Pre-Survey MAIT Scores for Each Instructor*

Instructor	**A**	**B**	**C**	**D**	**E**	**H**	**I**	**J**	**K**	**L**
Overall Average	3.71	3.08	3.67	3.29	3.96	4.17	3.67	4.29	4.17	3.88
Declarative Knowledge	17	15	15	16	17	19	12	18	15	17
Procedural Knowledge	14	10	13	12	13	16	13	16	18	16
Conditional Knowledge	15	11	15	14	17	16	15	18	17	15
Planning	17	10	14	14	16	15	16	18	18	14
Monitoring	16	15	16	15	16	18	18	17	17	18
Evaluation	10	13	15	8	16	16	14	16	15	13

(18 points). Instructors C and I scored the lowest on declarative knowledge, with an overall score of 12 points. Instructor B scored the lowest out of all instructors on procedural knowledge (10 points) and conditional knowledge (11 points). Instructors J and K scored the highest (18 points) for planning within the subset of metacognitive regulation, while Instructor B scored the lowest with 10 points for planning. Instructors C, H, I, and L scored the highest on monitoring (18 points), while Instructors B and D scored the lowest (15 points). For the domain of evaluation, Instructor D scored the lowest with a score of 8 points. Instructors E, H, and J scored the highest on evaluation (16 points).

The post-survey MAIT was administered to the PLC participants during Week 14 of the semester. Average scores on the post-survey MAIT and the metacognitive domains for each instructor are shown in Table 4.5. The overall changes from the pre-survey to post-survey MAIT are shown in italics under the post-survey scores. The highest overall

scores on the MAIT belonged to Instructor A (4.42 points) and Instructor K (4.67 points), both of whom had the greatest gains in their average score on the survey (+0.71 points and +0.50 points, respectively). The lowest overall scores were still from Instructor B (3.33 points) and Instructor D (3.13 points). While Instructor B increased their average score on the MAIT by +0.25 points, Instructor D's score decreased by -0.17 points. Instructors I and J also had decreases in their overall scores; Instructor I decreased by -0.21 points, and Instructor J decreased by -0.25 points, making them the two instructors with the least gain according to the survey. All other instructors demonstrated positive gains in their scores on the MAIT post-survey.

Within the subset of metacognitive knowledge, instructors had the most remarkable individual increases in the declarative and procedural knowledge domains. Declarative knowledge was the one domain where instructors tended to score the highest on the post-survey MAIT; Instructors E and H each had a total score of 20 points, while Instructors A, K, and L each had a total score of 19 points. Instructor K had the greatest increase in declarative knowledge with a positive change of +4 points in their overall score. Instructors E and I had an increase of +3 points on their declarative knowledge score. Conversely, Instructors D and J had a decrease of -1 point in their overall declarative knowledge score. All instructors, except Instructor D, who decreased by -1 point, increased their procedural knowledge scores. Instructors B and E had the greatest gains in procedural knowledge, with an overall increase of +3 points. Instructors A and L scored the highest with an increase of +3 points in conditional knowledge. Instructors D, I, and J decreased by -2 points, while all other instructors increased their conditional knowledge scores. In the subset of metacognitive knowledge, Instructor D decreased in

each knowledge domain. Similarly, Instructor J decreased their scores in the domains of declarative and conditional knowledge.

Within the subset of metacognitive regulation, instructors demonstrated the greatest gains in planning, followed by evaluation. Overall, instructors decreased their average score for monitoring, as shown in Table 4.3 and Table 4.5. The domains of monitoring and evaluation had the greatest variability in scores among instructors (Table 4.5). Instructors generally increased their planning scores on the post-survey MAIT; however, Instructors I and J decreased their scores by -2 points. Instructor K had the highest score for planning with 20 total points, with Instructor A close behind with 19 points. Although Instructor B had an increase of +2 points for planning, they had the lowest overall score (12 points) within that domain. Instructor B had no overall change in

Table 4.5 *Overall Post-Survey MAIT Scores for Each Instructor*

Instructor	**A**	**B**	**C**	**D**	**E**	**H**	**I**	**J**	**K**	**L**
Overall Average	4.42	3.33	4.04	3.13	4.29	4.29	3.46	4.04	4.67	4.33
(Change)	*+0.71*	*+0.25*	*+0.38*	*-0.17*	*+0.33*	*+0.13*	*-0.21*	*-0.25*	*+0.50*	*+0.46*
Declarative Knowledge	19	16	16	15	20	20	15	17	19	19
(Change)	*+2*	*+1*	*+1*	*-1*	*+3*	*+1*	*+3*	*-1*	*+4*	*+2*
Procedural Knowledge	16	13	15	10	16	18	15	18	19	17
(Change)	*+2*	*+3*	*+2*	*-2*	*+3*	*+2*	*+2*	*+2*	*+1*	*+1*
Conditional Knowledge	18	13	17	12	18	17	13	16	19	18
(Change)	*+3*	*+2*	*+2*	*-2*	*+1*	*+1*	*-2*	*-2*	*+2*	*+3*
Planning	19	12	16	16	17	16	14	16	20	16
(Change)	*+2*	*+2*	*+2*	*+2*	*+1*	*+1*	*-2*	*-2*	*+2*	*+2*
Monitoring	18	15	17	13	17	17	15	16	18	17
(Change)	*+2*	*0*	*+1*	*-2*	*+1*	*-1*	*-3*	*-1*	*+1*	*-1*
Evaluation	16	11	16	9	15	15	11	14	17	17
(Change)	*+6*	*-2*	*+1*	*+1*	*-1*	*-1*	*-3*	*-2*	*+2*	*+4*

their monitoring score, while Instructors A, C, E, and K increased their scores. Instructors D, H, I, J, and L decreased in their scores for monitoring. Instructor I had the greatest negative change of -3 points within this domain, while Instructor A had the greatest positive change and increased their total monitoring score by +2 points. Instructor A had the most remarkable change within the evaluation domain with an increase of +6 points, followed closely behind by Instructor L with an increase of +4 points. Instructors C, D, and K also increased their evaluation scores, but Instructors B, E, H, I, and J decreased in their score. Instructor I had the most noteworthy negative change with a decrease of -3 points for this domain. Instructor A had the most significant gains in the subset of metacognitive regulation when compared to the other instructors. Instructors I and J decreased their overall scores in each domain of metacognitive regulation.

In analyzing the change in instructor scores on the pre-survey MAIT and post-survey MAIT (Table 4.5), it was determined that overall, Instructor A and Instructor K had the greatest positive metacognitive gain according to assessment scores. Instructor A had the greatest change with an overall average score of 4.42 points and an increase of +0.71 points. Instructor K had the second greatest gain of +0.50 points yet had the highest average score of 4.67 points. Both Instructor A and K increased their scores in each domain of metacognitive knowledge and metacognitive regulation. Instructor I and Instructor J decreased in their score and had the greatest negative change according to the MAIT. Although they did not have the lowest scores out of all instructors, they did have the greatest decrease in scores. Instructor I had a final overall average of 3.46 points on the post-survey MAIT, with a decrease of -0.21 points. They increased scores in

declarative knowledge and procedural knowledge yet decreased scores in every other domain.

Similarly, Instructor J only increased their score in the procedural knowledge domain; they decreased scores in all other domains within metacognitive knowledge and metacognitive regulation. Instructor J's final average score was 4.09 points, with the most significant negative change of -0.25 points. Because of the final results on the post-survey MAIT, Instructors A, I, J, and K were selected for semi-structured interviews after the intervention was completed.

Instructor Questionnaires

Instructor questionnaires served as a qualitative data source and consisted of eight open-ended questions (Appendix B). Questions were designed to complement the MAIT and gain insight into the change that PLC participants experienced during the intervention. The questionnaire also questioned participants about their knowledge and perceptions of PLCs. Qualitative data analysis was performed by applying a coding scheme using NVivo software, which involved grouping similar information to observe patterns that emerged (Mertler, 2016). The categories that developed were used to group and code the qualitative data. Appendix E shows a complete account of instructor pre- and post-questionnaire answers.

Pre-Questionnaire Results

Pre-questionnaires were administered during Week 2 of the semester, before the intervention, to each of the research participants and the participant-researcher. After examining the individual answers to the pre-questionnaires, seven themes emerged (Table 4.6). The themes of (a) Learning & Improving Teaching, (b) Collaboration &

Communication, (c) Student Learning & Benefits, and (d) Common Goals & Input directly aligned with the characteristics of PLCs as described by DuFour et al. (2016). Participants talked about learning as teachers and improving their teaching practices ("Learning & Improving Teaching") 22 times throughout the questionnaire while also mentioning "Collaboration & Communication" a total of 24 times. The theme of "Learning and Improving Teaching" was most common in Questions 1, 3, 5, and 6. In Question 6 ("How do you anticipate your instructional strategies will change as you take part in the PLC?"), seven of the 10 instructors anticipated some change in instructional strategies or techniques. Note, however, that Instructor E and Instructor H did not answer Question 6. The theme of "Collaboration & Communication" was most common in Question 1 ("What do you understand to be the definition of a Professional Learning Community (PLC)?"). The theme of "Student Learning & Benefits" emerged 13 times, while "Common Goals & Input" were only mentioned six times. Instructors discussed students the most in Question 3 ("What do you anticipate learning by participating in the PLC?"), where seven of the 10 instructors talked about benefitting students and student learning. Concerning "Common Goals and Input," instructors remarked upon decision-making, goals, and change three times in Question 2 ("What perceptions do you currently have about PLCs?").

Interestingly, there were three other themes that illuminated the results of the MAIT pre-survey. These themes were labeled as "Efficiency & Lack of Time," "Reflection & Evaluation," and "Isolation." Instructors mentioned a lack of time a total of seven times, most frequently in Question 7. This question asked instructors to describe the planning and evaluation of their teaching. Instructor A, for example, responded to

Question 7, “With numerous emails, online teaching, hybrid teaching, etc., etc., there does not seem it be enough time to plan lessons.” The theme of “Reflection and Evaluation” emerged just four times on the pre-questionnaire. These answers were mixed in their tone. Some instructors wrote positively about their self-reflection, but some wrote negatively about it. Some negative sentiment was evident on Question 8, as Instructor B remarked, “I rarely self reflect. At the end of a class, I often feel drained and do not have the energy to put into reflection.” Instructor H had a more positive response, saying, “I always reflect on each lesson after I teach it. I am constantly thinking of new ways to improve teaching the same topic the next time.”

Finally, a surprising theme of “Isolation,” marked by a lack of collaboration, emerged. This theme was the most frequent in Questions 7 and 8, emerging seven times throughout the pre-questionnaire. For example, on Question 7 Instructor B noted, “I usually don't collaborate with others unless I need a fresh idea,” while Instructor E contributed their isolation to the new online environment that emerged due to the COVID-19 pandemic. Question 4 (“Have you ever participated in a PLC before? If so, what was your experience like?”) had no themes present; however, three participants were not sure if they had participated in a PLC before, and two participants suggested that the division-wide book study that met from 2018 to 2019 was a PLC. Instructor E stated that they had participated in a PLC before, possibly contributing to the tone of some of their answers. Instructor E revealed their prior experience with PLCs in multiple questions, uncovering some skepticism in the process. Instructor E’s response to Question 2 regarding their perceptions of PLCs was the following:

> [PLCs] have potential but are often lose direction and focus. To be effective there needs to be one or two distinct goals. They are commonly used to 'check the box' to show that something is being done. Often they become complaint sessions, focus on the exceptions, and are a waste of time.

Post-Questionnaire Results

Post-questionnaires were administered during Week 14 of the semester to each of the research participants and the participant-researcher. The frequency of each theme on the post-questionnaire for each instructor is shown in Table 4.7. The overall changes in each theme's frequency from the pre- to post-questionnaire are shown in italics within the table. A complete account of instructor questionnaire answers is shown in Appendix E.

Table 4.6 *Qualitative Themes of the Pre-Questionnaire*

Theme	**Frequency of Theme Per Question**								**Total**
	Q1	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**	
Learning & Improving Teaching	5	0	6	0	4	7	0	0	22
Collaboration & Communication	8	3	0	0	2	2	4	5	24
Student Learning & Benefits	2	2	6	0	0	3	0	0	13
Common Goals & Input	1	3	1	0	1	0	0	0	6
Efficiency & Lack of Time	0	0	1	0	0	0	5	1	7
Reflection & Evaluation	0	0	0	0	0	0	0	4	4
Isolation	0	0	0	0	0	0	5	2	7

The same seven themes from the pre-questionnaire were present in the post-questionnaire. Participants discussed "Learning and Improving Teaching" practices a total of 13 times, mentioning this theme nine fewer times on the post-questionnaire when compared to the pre-questionnaire. Instructors also mentioned "Student Learning & Benefits" fewer times, just six times throughout the post-questionnaire. The theme of "Common Goals & Input" appeared four times, its frequency remaining relatively constant throughout the post-questionnaire. Likewise, the theme of "Reflection &

Table 4.7 *Qualitative Themes of the Post-Questionnaire*

Theme	**Frequency of Theme Per Question**								**Total**
	Q1	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**	
Learning & Improving Teaching	3	1	3	1	5	0	0	0	13
(Change)	*-2*	*+1*	*-3*	*+1*	*+1*	*-7*	*0*	*0*	*-9*
Collaboration & Communication	8	3	7	5	3	0	3	1	30
(Change)	*0*	*0*	*+7*	*+5*	*+1*	*-2*	*-1*	*-4*	*+6*
Student Learning & Benefits	2	0	2	0	1	1	0	0	6
(Change)	*0*	*-2*	*-4*	*0*	*+1*	*-2*	*0*	*0*	*-7*
Common Goals & Input	1	1	1	1	0	0	0	0	4
(Change)	*0*	*-2*	*0*	*+1*	*-1*	*0*	*0*	*0*	*-2*
Efficiency & Lack of Time	0	0	0	0	0	0	1	0	1
(Change)	*0*	*0*	*-1*	*0*	*0*	*0*	*-4*	*-1*	*-6*
Reflection & Evaluation	0	0	0	0	2	0	0	2	4
(Change)	*0*	*0*	*0*	*0*	*+2*	*0*	*0*	*-2*	*0*
Isolation	0	0	0	2	2	0	3	4	11
(Change)	*0*	*0*	*0*	*+2*	*+2*	*0*	*-2*	*+2*	*+4*

Evaluation" remained the same. There were some observable differences in how instructors articulated the time they spent reflecting. As mentioned previously, on the pre-questionnaire, Instructor B noted on Question 8 that they "rarely self reflect," but on the post-questionnaire, they expressed that they spend extra time reflecting when they feel a lesson did not go well.

The most notable changes were in the themes of "Efficiency & Lack of Time," "Isolation," and "Communication & Collaboration." The frequency of the theme of "Efficiency & Lack of Time" decreased from seven times on the pre-questionnaire to just once on the post-questionnaire. On Question 7 ("How much time do you spend planning lessons before class? How is this time divided between designing the lesson and collaborating with colleagues about that lesson?") of the post-questionnaire, Instructor B mentioned that "I unfortunately have not had much time to plan lessons for the past several semesters." On Question 7 and Question 8, the amount of time instructors reported preparing for class did not change significantly overall. There was a decrease, however, in their expressing time as a limiting factor in their preparation. For example, on the pre-questionnaire response to Question 7, Instructor A cited a lack of time in planning lessons, whereas, on the post-questionnaire, Instructor A answered, "45 minutes to 1 hour of review, prep time, thinking of different ways to teach a particular topic prior to class."

Instructor expression of isolation, or lack of collaboration, increased from seven times to 11 times between the pre-questionnaire and post-questionnaire, while their discussion of "Communication & Collaboration" increased from 24 times to 30 times. In general, there appeared to be a positive change in how the instructors spoke about

collaboration with their colleagues. On Question 8 of the pre-questionnaire, Instructor I stated, “I have not had much time reflecting on the lesson with other colleagues.” When asked the same question again on the post-questionnaire, Instructor I said, “My collaboration with other instructors still needs more improvement.”

Within the theme of “Communication & Collaboration” on the post-questionnaire, a sub-theme emerged four times in which multiple instructors used specific language to express a sense of community and commiseration. Some instructors, such as Instructor A, expressed this as “commiserating with colleagues,” while Instructor K described there being shared issues among instructors. Instructor B also commented on shared issues, noting on Question 4,

> As one of only a small amount of instructors teaching a specific subject, I felt that I couldn't ask for help or insight since other instructors were not familiar with my topics. Through the PLC, it has opened my eyes that we are all going through similar problems, even if my colleagues might not be able to help come up with an idea for a specific topic in my lesson.

This feeling was shared by Instructor L, who went so far as to say, “I feel validated and reassured that I am doing things correctly and it gives me confidence to follow my instincts when I am trying out new techniques.”

It should be noted that while some instructors, such as Instructor B, described the PLC as “an opportunity for colleagues to come together and brainstorm/vent/share ideas regarding current tasks and issues in the department” and described their experience positively, others did not share that sentiment. Instructor E appeared to disagree, stating, “I love to talk and discuss with my colleagues but it is hard when we went off topic so

much and rarely discussed useful professional learning technique." Instructor D seemed to have a different perspective, noting, "at first it was a venting session. In time we learn [sic] how to make use of our 30 min sessions." Likewise, Instructors B and D commented on the need for structure and organization within the PLC meetings.

Word Frequency Analysis in Pre- and Post-Questionnaires. Further analysis of the pre-and post-questionnaires revealed certain words, stemmed words, and synonyms repeated throughout the questionnaires. For example, the word *class* and its stemmed words (e.g., *classes*) and synonyms (e.g., *courses*) appeared multiple times. An analysis of word frequency was conducted using NVivo software to do an initial tally of each word's instance. A summary of word frequency changes between the pre- and post-questionnaires is shown in Table 4.8.

Table 4.8 *Word Frequency Analysis in the Pre- and Post-Questionnaires*

Word(s)	**Pre-Questionnaire Frequency**	**Post-Questionnaire Frequency**
class(es) *(course(s), lab, lecture)*	22	33
collaborate, collaboration, collaborating *(contribute, commiserate)*	12	16
colleague(s) *(group, team)*	18	29
help(s), helpful, helping	9	20
instructor(s) *(educator(s), teacher(s))*	12	23
online *(hybrid)*	5	9
student(s)	23	15
talk *(discuss, share)*	9	24
technique(s) *(tool(s))*	6	23

There was a shift in instructors' language to describe their perceptions of and experiences within the PLC, based upon the word frequency analysis. In general, the overall tone of most instructor responses on the post-questionnaire was positive. The word “help” and its derivatives were used 20 times, increasing from nine times on the pre-questionnaire. The PLC participants spoke more about their classes in the post-questionnaire (33 times) than the pre-questionnaire (22 times). They also discussed the online environment and online classes more in the post-questionnaire. Surprisingly, instructors explicitly mentioned students less in the post-questionnaire; they included the word “student” or “students” just 15 times in the post-questionnaire compared to 23 times in the pre-questionnaire. Although instructor discussion of teaching, instruction, and learning remained relatively constant on the pre- and post-questionnaires, they expressly referred more to learning techniques and tools on the post-questionnaire. Finally, the PLC participants wrote more about their colleagues and collaboration on the post questionnaire than on the pre-questionnaire. Participants mentioned the word “instructor” and its derivatives 12 times on the pre-questionnaire, yet used it 23 times on the post-questionnaire. Participants wrote about collaboration 12 times on the pre-questionnaire, but they mentioned it 16 times and used more varied language to discuss it on the post-questionnaire. They discussed colleagues and the “group” or “team” of instructors more on the post-questionnaire. Notably, the instructors wrote more about communication on the post-questionnaire, with the word “talk” and its stemmed words and synonyms appearing more frequently.

Semi-Structured Interview Results

Semi-structured interviews served as the final data collection method for participants who showed the least and greatest gains in metacognition, according to the MAIT. PLC participants were selected for an interview after the PLC meetings ended during Week 15 of the semester. The two instructors with the most positive change in score on the MAIT, and the two instructors with the most negative change in score on the MAIT, were selected for interviews. On the post-survey MAIT, Instructor A had the greatest positive gain in their score with a net change of +0.71 points. Instructor K had a net change of +0.50 points and had the highest overall score on the post-survey MAIT (4.67 points). Instructor I had the second-greatest negative gain in their score, with a change of -0.21 points that resulted in a post-survey MAIT score of 3.46 points. Instructor J had the greatest negative change in score. Although Instructor J began with the highest score on the pre-survey MAIT (4.29 points), they decreased by -0.25 points to a final post-survey MAIT score of 4.04 points. Raw data from the semi-structured interview transcripts are showed in Appendix F. This section of data was analyzed first by theme, then by question. A discussion and synthesis of each instructor's triangulated results and analysis of their metacognitive statements are also included.

Semi-Structured Interview Results by Theme

Six themes emerged from the analysis of interview transcripts. The overall frequency of themes that emerged during the semi-structured interviews is illustrated in Table 4.9. Four themes that were present in the pre- and post-questionnaires were also discovered in the semi-structured interviews: “Collaboration & Communication,” “Learning & Improving Teaching,” “Reflection & Evaluation,” and “Student Learning &

Table 4.9 *Qualitative Themes of the Semi-Structured Interview Instructor Responses*

Theme	Frequency of Theme Per Instructor				Total
	A	I	J	K	
Collaboration & Communication	4	16	9	4	33
Commiseration	9	3	7	5	24
Learning & Improving Teaching	4	5	8	2	19
Online Teaching	5	1	4	2	12
Reflection & Evaluation	6	6	11	6	29
Student Learning & Benefits	6	4	8	8	26

Benefits." The participants interviewed shared sentiments of commiseration, validation, camaraderie, and shared perspectives within the group of instructors taking part in the PLC, leading to the theme of "Commiseration." Instructors frequently mentioned feedback and online teaching and learning during the interviews as well. Although the word *online* appeared more frequently in the post-questionnaire, "Online Teaching" was not a code used before the interview analysis. *Feedback* was also a term and theme that did not emerge before the semi-structured interviews began. It is included as part of "Reflection & Evaluation" since instructors discussed feedback as part of their self-reflection and self-evaluation process.

Collaboration and Communication. The theme of "Collaboration & Communication" appeared throughout the four instructors' interview transcripts a total of 33 times, making it the most frequently occurring theme. Instructor A and Instructor K mentioned collaboration and communication just four times each, while Instructor J discussed it nine times. Instructor I discussed this theme the most, a total of 16 times

throughout their interview. During the interviews, each participant described working with other instructors from the PLC during the semester. Instructor A, Instructor I, and Instructor J went so far as to talk about specific instances in which they collaborated with other instructors outside of the PLC meetings. With respect to collaborating with Instructor K, Instructor I stated, "Contacting [Instructor K] I think that had the most influence for how I was teaching along with… at least providing…some insight for how the next semester… could be improved." Instructor I, Instructor J, and Instructor K also mentioned how they worked with adjunct instructors during the semester as they participated in the PLC. While Instructor I commented on sharing resources with adjunct instructors, Instructor J mentioned attending an adjunct instructor's class to gain more insight into different teaching techniques. Instructor J commented on this continued collaboration as a result of sharing teaching techniques within the PLC, saying, "I thought [the teaching technique] was the good thing... and so I think that our meetings also gave me this possibility to…watch other people." Instructor K discussed the change in working with adjunct instructors after discussions within the PLC, stating, "it helps me become more aware of not only my own style and my own preferences, but the adjuncts that I work with…I need to be aware of how the different instructors approach things as well."

Commiseration. Taking collaboration and communication one step further, instructors shared feelings of commiseration and validation from taking part in the PLC. Some instructors also expressed having new perspectives as a result of participating in the PLC. The way instructors discussed "Collaboration & Communication" referred to actions, but how they discussed "Commiseration" reflected how the experience made

them feel. This theme emerged a total of 24 times, with Instructor I and Instructor K discussing commiseration the least, a total of three times and five times, respectively. Instructor A discussed this theme a total of nine times, and Instructor K discussed it seven times. When asked about the PLC experience, Instructor A specifically used the term "camaraderie" as an enjoyable aspect of the PLC meetings and sharing ideas on improving teaching.

Student Learning and Benefits. Although the theme of "Student Learning & Benefits" appeared less on the post-questionnaire, instructors who were interviewed spoke about the benefits to student learning due to the changes made to their teaching while participating in the PLC. Instructor A discussed student learning and benefits six times during the interview, while Instructor I discussed this theme just four times. However, Instructor I did identify communication as a weakness they had and even discussed improving communication with students. Instructor J and Instructor K each discussed this theme eight times during the interviews. Instructor J was very focused on student engagement and involvement, particularly in the online environment, saying, "I take responsibility for my students if…they fail so that that's the big thing. Just trying to improve how I present the material and hope that my presentation will help students understanding the concepts." Instructor J also discussed their experience in the PLC regarding issues of equity in education. Instructor K discussed planning courses and setting expectations for a class to help set students up for success. They mentioned they opted not to change their instruction mid-semester since changing a routine or "structure" of the course mid-semester may disrupt student learning.

Learning and Improving Teaching. The theme of "Learning & Improving Teaching" emerged 19 times, with Instructor J discussing the theme eight times. Instructor I discussed this theme five times, Instructor A talked about improving their teaching four times, and Instructor K mentioned it only twice. Interestingly, the improvements identified by each instructor varied as a result of taking part in the PLC. Instructor A focused on teaching techniques and skills, while Instructor I discussed instances where they collaborated with other instructors to improve teaching. Instructor J's responses were mostly student-focused, with their interview answers mentioning improvement of teaching to increase student engagement; their responses coded as "Student Learning & Benefits" were typically followed by a response coded as "Learning & Improving Teaching." Instructor K had very concrete examples of how they would improve their courses for next semester. They did not feel that their instruction improved since they were teaching online, but their understanding of how to teach online improved.

Reflection and Evaluation. "Reflection & Evaluation" appeared more frequently in the semi-structured interviews for each instructor than it did on the pre- or post-questionnaire. In the interviews, the instructors were better able to articulate how they reflected and evaluated their teaching practices. During the interviews, Instructor A, Instructor I, and Instructor J discussed the role that student feedback and evaluations had in their teaching, self-reflection, and self-evaluation. Instructor A explicitly discussed reflection just once during the interview but described instances of using feedback from students and instructors in their reflective process. While the feedback from other instructors served to validate and inspire Instructor A to make instructional changes, the student feedback motivated them to make those changes. Instructor I discussed this theme

of “Reflection & Evaluation” three times. Instructor J gave multiple concrete examples of when and how they reflected upon their teaching. On the contrary, Instructor K did not give as many narrative examples of how they reflected, but instead, they explicitly said they reflected.

Online Teaching. Finally, a common thread of “Online Teaching” appeared on the semi-structured interviews as it had in the word frequency analysis on the post-questionnaires. Instructor I mentioned online teaching only once during the interview, commenting on a common difficulty of the instructors in the science department: “we're still constantly learning how to do this effectively online…we're trying to compare it with how we did in person.” Instructor K mentioned “online” twice. Instructor A and Instructor J mentioned being “online” more frequently, discussing it five and four times, respectively. Like what Instructor I said, Instructor J noted that with being online, “we have new challenges. We have to come up with new ways of doing things.”

Semi-Structured Interview Analysis by Question

After conducting a generalized thematic analysis of the semi-structured interview transcripts, each question was examined to compare and contrast instructor responses.

Perceptions of the PLC. The first question on the semi-structured interviews was, “What did you enjoy the most from the PLC? The least?” In response to this question, all four instructors reported positively. Each instructors’ answer carried the common theme of “Commiseration,” and all instructors except Instructor K discussed “Collaboration & Communication” in their answers. Instructor I, Instructor J, and Instructor K explicitly mentioned “perspective” in their responses. Instructor J stated, “Well, I guess that the best thing was realizing I'm not the only one…Difficulty is we

need to change it out, you know, getting everybody's…perspective on…how they are doing things." Instructor A mentioned multiple aspects of what they liked about the PLC meetings, saying that,

> Part of it was just being with colleagues, and I think sharing a lot of the same issues that we all have and I think venting, venting was very helpful, especially when times within the semester were frustrating. You could kind of vent, and I think that's beneficial because it makes you feel like you're not alone. You know that you're not the only one dealing with those issues.

Instructor A also discussed sharing ideas between PLC participants, stating that some instructors have different strategies to share.

When discussing what instructors enjoyed the least, answers were still positive in their sentiment, yet all mentioned PLC participants going off-topic or complaining during PLC meetings. This observation was mentioned in the post-questionnaire, but participants went into more detail regarding their thoughts on the matter during interviews. Instructor I did not enjoy the complaining but said, "it was necessary to know where the problems are so we can work together." Instructor J had a different perspective and had a positive outlook, saying, "we're able to vent and nag and support each other." Later in the interview, Instructor J especially mentioned how venting and sharing difficulties helped them self-reflect. Regarding growth within the PLC, Instructor I also stated that after listening to other instructors, they stated, "I realized I haven't been doing as much as I thought by listening to everyone else when I was in the PLC. Listen to their strategies. Listen to their communication, and I realized how much I'm still lacking."

Prior Experiences. Question 2 in the semi-structured interviews was, "What other experiences have you had as part of an organized group of educators. What benefits did you gain from that?" and Question 3 asked, "How has participating in the PLC been different from other groups of educators you have met with regularly?" Themes of "Collaboration & Communication" and "Learning & Improving Teaching" emerged again, and instructors were more reflective in comparing and contrasting the differences in the PLC and other experiences they have had. Instructor A and Instructor K associated the PLC meetings with the division-wide book study completed between 2018 and 2019. When relating the PLC to the book study, Instructor K observed that the book study focused on "a topic that the author had generated, and we were responding to it. The [PLC] was the issues that we generated. And I think that's where it really had a lot of importance for me." Instructor A had similar sentiments, noting that the PLC dealt with "the current topic…the current issue that was going on with students." Instructor A reflected upon one example of an issue during the semester with testing software and academic integrity. They said,

> I immediately got feedback from other instructors about what they were doing, what they were seeing, and it either verified what I saw, but it also gave me other things to look at, so it kind of gave me immediate information. Immediate data that I could use, like as soon as we hung up.

Instructor I compared the PLC meetings to teaching assistant meetings and conferences they attended in the past. They commented on the impact of the PLC meeting regularly. They stated there was "a continual growth through the several meetings," and the PLC promoted that by keeping all instructors informed on a regular basis.

Instructor J noted the new challenges in being online for meetings and classes versus in-person since instructors had to develop "new ways of doing things." They stated that nothing the department had done before was as "extensive and…helpful" as the PLC and said that the PLC meetings were "more helpful on teaching and how to get the students to get engaged, especially in the online classes." Instructor J contrasted their prior experience in once-per-semester curriculum meetings with instructors from just one course, Anatomy & Physiology (A&P). Instructor J elaborated on this, saying,

> The good thing with the meeting…this way it is…just having instructors from different classes. Letting me or us…know how things are working and getting help from them because…when you only talk to people who teach the same thing, y'all may not be looking…outside the box. I just think this is the only way, but when other people…chime in, then it makes a difference.

Instructor J also contrasted the PLC meetings with department-wide division meetings, noting, "Our division meetings... I don't think they ever had all of us talking about our classes. How to handle the problems we all face…it really didn't have much of anything to do with teaching."

Instructional Changes. Question 4 of the semi-structured interview asked instructors, "What kind of things have you changed in your instruction because of this experience?" Instructor K remarked that they were hesitant to change the structure of their courses mid-semester because they did not want to change the "routine" they had already set up for students, lest it disrupts student learning. When asked additional follow-up questions, Instructor K revealed that they do not anticipate making "major shifts" in their teaching because of their extensive teaching career. They said that they are

"into more fine-tuning" their practice. Instructor K did note that although they did not think their instruction improved, their understanding of *how* to do online instruction improved. They attributed this improvement to the PLC and in "listening to other people talk about how they approach their classes and working through various issues." They also reflected upon the experience of the students in their classes, noting that because they have many students who are also in Anatomy & Physiology (A&P), that "it might not hurt me in the online situation to be a little more like the A&P so that it would fit a little more to their comfort zone." Instructor K felt that although the PLC did not help with the actual instruction, it helped them plan for the next semester. The PLC also helped Instructor K evaluate their teaching and working with other people, noting that it helped them become more aware of their teaching preferences and the preferences of other instructors and students.

Instructor A, Instructor I, and Instructor J were less hesitant to change their courses during the semester. Instructor I, in particular, made changes after soliciting student feedback. Although Instructor I did not participate in every PLC meeting, they described how they made instructional improvements. In regard to progress that they could attribute to the PLC, Instructor I noted that "being transparent with not only students more, but with other instructors that actually was the most improvement I've seen in the PLC." They were able to use other instructors' knowledge and use their perspectives to make improvements. Instructor I was asked a follow-up question by the participant-researcher, which was as follows: "Do you feel that the PLC helped you evaluate your teaching or change the way that you think about your teaching in any way?" Instructor I replied,

> Immensely it has. That's one area I would love to improve more is…how do I reflect…more, listen more to the students. Rather than…how I feel like I can do it. Getting actual feedback and acting on that feedback that's, I think, helped me the most with the PLC that the PLC's helped me realize that even further, is that the students dictate…your improvement.

Additionally, Instructor I remarked upon the change they say this semester with students, saying, “I've had more students email me with thank you’s, more positive encouragement this semester than I've had in the previous two semesters.” They stated that the PLC helped them build a connection between receiving feedback, communication with instructors and students, and organization. By building connections with other instructors, Instructor I felt more comfortable talking to other instructors and attending other instructors’ classes. Within the PLC context, Instructor I noted that they learned effective teaching strategies from Instructor D during a PLC meeting where participants shared teaching techniques. Learning about how different the science courses are and talking with other instructors also helped Instructor I. They stated that concerning problems they encounter:

> We may not have thought of that because…each instructor may have a different way of handling it, and so bringing those affected our teaching strategies…it's hard to visualize without having someone else…doing it and then seeing it from a different perspective. You only see it from your own.

They also expressed feelings of being less isolated, saying, “I don't feel like I was on a tiny little island for the chemistry side and I can talk with other instructors more.”

When asked about what they had changed in their instruction due to the PLC, Instructor A spoke about the changes they made in response to the online teaching environment. They described online teaching as "foreign," because they preferred face-to-face teaching where they felt they performed their best. Within the PLC, Instructor A felt validated in what they were doing in their instruction. Instructor A got ideas and suggestions of new things to try while teaching. The other instructors provided Instructor A with the validation that their strategies were working. Instructor A noted since they were online, they felt like they could immediately implement a new strategy during the next class, especially if it is a "little thing" or "little trick" that does not take much preparation. For example, Instructor A discussed how they noticed their students were not engaged during online lectures and did not know if their students were present at their computer during class. From the PLC, they got the inspiration to try the polling feature on the learning management system online teaching platform.

In reply to the same question, Instructor J remarked that their teaching had been "more or less the same," in which they reviewed their PowerPoint presentation before and after class. Instructor J said the PLC caused them to "look at…how I present things and how I can change it really to improve my presentation to get students to…be involved, or engaged or, you know, get the point across." They stated that they taught lecture online the previous semester like they had in face-to-face classes and did not think it was best. In reflecting upon this, Instructor J said, "I need to do something different. I don't think my lectures were very good." About the PLC, Instructor J said, "going through talking to everybody, I think not only on my online lectures will be definitely different, probably face-to-face eventually will be a bit different, too." As a follow-up

question, the participant-researcher asked Instructor J about some of their answers on the post-MAIT survey, where the survey score decreased. For example, on the question on the MAIT, "after teaching a point, I ask myself if I'd teach it more effectively next time" Instructor J scored themselves lower on the question at the end of the semester. They replied that they felt prepared at the beginning of the semester, but "everything was so hectic, and there was not a lot of time," so their attention was pulled away from teaching. In hindsight, they will be making changes to their courses to keep students more involved and incorporate different techniques. Similar to Instructor I, Instructor J stated that the PLC meetings enabled them to watch other instructors teach and incorporate things they would like to try in class.

The Motivation for Change. In response to Question 5 ("What motivated you to make changes in your instruction?"), the instructors all responded that their primary motivation centered upon their students. Instructor K briefly stated that they were motivated to help students prepare, while Instructor A wanted to help students learn to study and succeed in their class. Instructor I noted that students' feedback made them motivated to make changes in their teaching, and seeing results such as student participation was a driving factor. Instructor J jokingly replied that their motivation came from "trying to do a better job," but remarked upon student evaluations and learning how others solve problems. They elaborated upon this, saying, "anything that…I do…has to do with how I can improve my teaching 'cause I don't wanna be…doing the same thing over and over and over" and putting the responsibility solely on the students. Instructor J said they wanted to improve how they present the course material to help students understand the concepts.

Later in the interview, Instructor A was asked about their final score on the post-survey MAIT since they dramatically improved their self-evaluation. Instructor A attributed their change in mindset to the sharing of concepts that occurred in the PLC. They noted that the sharing between instructors gave them more motivation to use new techniques immediately, and then the feedback from students motivated them more to make changes in their instruction. They also commented that in the virtual format of classes, they felt students were more likely to share their feedback and feel comfortable responding. The students' feedback perpetuated a cycle where Instructor A felt confident in applying the changes in teaching that were inspired by others in the PLC.

Impact of the PLC. Question 6 asked instructors to identify what had the most impact throughout the process of the PLC intervention. Instructor A thought that the experience would help with planning their teaching for the following semester since many of the things they learned in the PLC could be applied from the first day of class. The PLC also helped them evaluate their teaching and how they think about their teaching. Instructor A stated, “it helps me to focus on an area that I never had to deal with before.” Simply put, Instructor A said that the thing that had the most impact was validation. They expounded upon their statement, saying,

> What I mean by that is, because we're all isolated for the most part…I found it important that when we are we got together even though it was virtual, to validate your feelings, your frustrations, those things that were going on that we all were thrown into by no one's choice. That like, OK, I'm not the only one dealing with this. You know everyone else feels the same way. This is how they're handling it.

Instructor A later spoke of the camaraderie within the group of PLC participants saying, "I think our crew, overall, we're pretty open and fun" and "it's just the nature of our group…that's why I think we could joke. We could tease each other. We could get angry with each other and still be good."

Instructor I noted the PLC's influence on their reflection and teaching, especially when they contacted Instructor K outside of the PLC. They said,

> Without the PLC, to be honest, I would not have made those connections. So, I think that was the best thing was the PLC helped bring everybody together and help with providing that insight. So that way they can honestly constantly improve together, rather than on their own.

The factor that Instructor I thought had the most impact was "teacher-to-teacher communication," especially in making connections and being transparent.

Instructor K thought the time between meetings had the most impact on them when reflecting upon the discussion after the fact. Instructor K stated that, "I think I rarely have my best thoughts within the confines of a meeting. I think if we address an issue, talk about some ideas, and then go back and come back in in a week or two and give people a chance to process it and really think through it, I think we get…better ideas." When asked a follow-up question about the PLC, Instructor K said the PLC is the most helpful thing our department can do, "particularly because we deal with so many different students." They noted that the Anatomy & Physiology instructors meet periodically, but the meetings are "so focused on A&P that…sometimes we lose sight of the bigger picture," and "for that…the PLC is really advantageous."

Instructor J discussed many aspects of the PLC that impacted them, especially when asked a follow-up question about their post-questionnaire answers. The thing that Instructor J identified as having the most impact was "that I'm not alone in this." In this sentiment, Instructor J felt validated in their instruction and the changes they were making. They went so far as to say, "hearing other people are struggling the same way you're struggling" and "talking about and think, what can we do to change it?" In regard to this, Instructor J noted that often one could feel isolated, but within the PLC, they felt like they were not alone and could figure out solutions with others. As Instructor J observed, it is

> because it's different classes I think that was the big deal in making a difference…even like I would ask [the participant-researcher] something, and you go, "we'll get [Instructor K] and [Instructor B] and [Instructor I] involved because they may have a different perspective." You know, before, it wouldn't even cross my mind. I'm like, well, they're not teaching A&P, so they're not going to understand. Then, when you brought it and got them into a conversation, yeah, it was somebody looking from outside and going, "well, let's look at it this way."

Instructor J also reflected upon their class that semester. They had trouble getting students engaged and received mildly negative feedback from students on their end-of-course evaluations. Instructor J noted that within the PLC, it was valuable "just learning from each other how to solve the problems that we all have. I think everybody struggles trying to get students being engaged."

Instructor J was asked a follow-up question about their post-questionnaire answers where they remarked about being more sensitive to students and being a more

compassionate instructor. Instructor J said that during one PLC meeting, Instructor D and Instructor K discussed equity issues. After the meeting, Instructor K sent an image depicting the difference between equality and equity. Instructor J said,

> That image really just still stuck in my head, you know, equality giving everybody the same thing, but does that really help everybody? …and that image I think more than anything else…stuck in my head that…it might sound good…but this really doesn't look good when [the] result is not that good…When you want to treat everybody exactly the same and not think about all the different situations.

Instructor J cited this as one of the most impactful aspects for them, causing them to shift how they think about students and course policies and try to be more understanding and compassionate. This discussion within the PLC, as mentioned earlier in Chapter 4, was the impetus to have a committee of instructors collaborate to review student complaints and issues with testing.

Finally, Instructor J discussed how the PLC helped them reflect upon themselves as instructors discussed problems they face and how to develop solutions. Instructor J said, "When you're ranting about it and realizing everybody is in the same boat like, 'OK, now what do we do?'" They also had the realization that "you vent and you realize you're the only one…this problem and you have to look back and go, 'OK. What do I need to do? Why am I the only person that this thing doesn't work for?'" Instructor J mentioned that when they were the only person with a problem, they could see how others handled that situation. They discussed how they realized that if they are the only person having an issue, then the problem has something to do with themselves.

Results by Instructor

The MAIT surveys, instructor questionnaires, and semi-structured interviews gave a well-rounded view of the instructors' experience from participating in the PLC and how it contributed to their change in metacognition, as measured by the pre- and post-survey MAIT. Within the pre- and post-questionnaire, instructor responses gave insight into their answer selections on the MAIT. In an additional evaluation of the semi-structured interviews, answers provided meaning to the scores on each subset of metacognition (metacognitive knowledge and metacognitive regulation) and each domain therein. All instructors made several metacognitive statements during the interviews, which gave a deeper understanding of how the PLC impacted instructor metacognition and teaching metacognitively. A review of the synthesized data for Instructors A, I, J, and K are discussed here, along with a presentation of the metacognitive statements.

Instructor A. Instructor A showed the most significant gains on the MAIT with an overall increase of +0.71 points from an average score of 3.71 points on the pre-survey MAIT to a score of 4.42 points on the post-survey MAIT. They showed increases in their average score for the subsets of metacognitive knowledge and metacognitive regulation. Their metacognitive knowledge score increased from 15.33 points on the pre-survey MAIT to 17.67 points on the post-survey MAIT. Instructor A's metacognitive regulation score increased from 14.33 points on the pre-survey MAIT to 17.67 points on the post-survey MAIT. Instructor A increased in all metacognitive knowledge and metacognitive regulation domains, with the largest increases in conditional knowledge and evaluating. They had the largest increase in any domain out of all instructors, with a change of +6 points in evaluating.

On the pre-questionnaire, it was evident that Instructor A anticipated the PLC to "provide for me more innovative techniques and methods of teaching that will directly benefit my students," indicative of an anticipated change in their conditional knowledge. Conditional knowledge with respect to teaching is knowing when and why to use various strategies to enhance student learning (Balcikanli, 2011). Instructor A elaborated upon this in the pre-questionnaire, saying that "new or different instructional strategies would directly equate to a deeper knowledge of the material and thereby relate to better grades."

Instructor A made statements during the semi-structured interviews that revealed their gains in metacognitive knowledge and metacognitive regulation. Many of their metacognitive statements, however, described multiple domains of metacognition. For example, in the semi-structured interview, Instructor A described their change in conditional knowledge when they described how they selected strategies to enhance student learning. In the interview, Instructor A discussed using polling as a formative assessment to improve student engagement. They used the feedback from the polling and casual student comments to monitor their teaching. Metacognitive monitoring is a metacognitive regulation domain that allows one to assess learning or strategy use and assess their strengths and weaknesses (Schraw & Dennison, 1994). Regarding metacognitive teaching, monitoring may be self-assessment of teaching or using formative assessments to monitor student learning (Balcikanli, 2011). It allowed Instructor A to assess their instructional techniques and use formative assessments to measure student comprehension. For example, Instructor A noted that "polling just gave me another tool to get students…to engage a little bit, throw out answers, you know, do little things like that…as you're going along." This particular tool allowed Instructor A to

get immediate feedback that enabled them to try additional techniques during class. Instructor A described this as giving them self-motivation and confidence to try additional techniques. They said, “I think that's what kind of perpetuated that process from the beginning to the end.” In addition to exemplifying conditional knowledge and monitoring, this also demonstrates Instructor A’s procedural knowledge, the awareness of the techniques to use while teaching.

Instructor A also described a change in their planning and evaluation due to attending the PLC meetings. Metacognitive planning is selecting appropriate strategies, setting goals, and managing time (Schraw & Dennison, 1994); planning while teaching could include pacing oneself during instruction, setting goals for a lesson, or creating a course (Balcikanli, 2011). Instructor A said that after learning techniques in the PLC, they would "use those things from day one. I'm gonna use different things that I picked up…during the various points of those meetings, and now I have those things that I can then use…from day one in the next semester.” This statement illuminates the change in Instructor A’s planning and evaluation as a result of the PLC.

The collaboration with other instructors allowed Instructor A to compare strategies. They felt validated and expressed a change in declarative knowledge as they assessed their strengths and weaknesses in teaching. Again, Instructor A expressed changes in conditional knowledge regarding the selection of specific teaching techniques. They also described evaluating their teaching, saying that the validation from other instructors and hearing what they do in class helped them know they were correct in their instructional choices. When planning instruction, Instructor A described the fast implementation that was possible after the PLC, saying, “because you're online, you

could…literally do it….your next class, you know you could implement that little thing. It doesn't take a whole lot of preparation to…try to do a little more engaging with students… That should take me two seconds to do a little polling thing to try to get students more engaged."

Instructor I. On the MAIT, Instructor I had a decrease in score from 3.67 points on the pre-survey to 3.46 points on the post-survey. Instructor I's overall score on metacognitive knowledge increased from the pre- to post-survey MAIT. While Instructor I increased their score on declarative and procedural knowledge by the end of the semester, their conditional knowledge score decreased by -2 points. Additionally, their overall average score for metacognitive regulation decreased; Instructor I decreased in score on all domains of metacognitive regulation: planning, monitoring, and evaluating. Despite this decrease, Instructor I still made several metacognitive statements during the post-questionnaire and semi-structured interview, which suggested that, despite scoring lower on the post-survey MAIT, they made metacognitive gains in the areas in which their scores decreased.

Like Instructor A, Instructor I expressed on the pre-questionnaire that they anticipated learning new ways to teach effectively to benefit students, reflecting anticipation in gaining conditional knowledge. On the post-questionnaire, Instructor I stated, "The PLC helped promote growth as an instructor and learn how to tackle situations that have occurred during the semester and provide insight into challenges yet to come." This statement suggests that Instructor I had evaluated their instructional practices since metacognitive evaluation involves reflection upon which strategies were effective in a given circumstance and what should be changed next time one encounters

that situation (Balcikanli, 2011). Instructor I also noted that they "learned how to effectively prepare and teach using different strategies," suggesting that they improved both in their metacognitive knowledge and metacognitive regulation. This statement gave insight into Instructor I's procedural knowledge and planning since Instructor I would prepare a lesson and select appropriate strategies for it.

Instructor I mentioned comparing themselves to others, saying, "I realized I haven't been doing as much as I thought by listening to everyone else when I was in the PLC… I realized how much I'm still lacking." This statement indicates Instructor I's declarative knowledge since they became more aware of their strengths and weaknesses by listening to and talking with other instructors. This introspection led Instructor I to reflect more about the areas they need to improve, such as communicating with other instructors and students. At multiple points during the interview, Instructor I identified communication as a weakness. They noted that they would like to improve their reflection and "getting actual feedback and acting on that feedback." Instructor I used this language to describe a desire to improve their evaluation.

Additionally, when asked what they changed in their instruction as a result of the PLC experience, Instructor I replied that they learned effective teaching strategies, especially from Instructor D. They also described learning from other instructors with more experience, stating, "If you've been teaching longer, you have…much more experience handling a lot of situations. By using…previous strategies that have worked in the past and then trying to see if there [are]…new strategies that could be even as effective." Instructor I even mentioned continuing to work with other instructors and go to their classes to review their strategies. These statements indicate that Instructor I hoped

to gain procedural knowledge from learning valuable strategies and gain insight into other instructors' conditional knowledge. Instructor I credited the PLC for making connections with other instructors during the semester, which contributed to their ability to plan their instruction for the next semester. Finally, Instructor I made multiple comments regarding feedback that indicated they were utilizing metacognitive monitoring throughout the semester. During the interview, Instructor I mentioned using feedback from other instructors as well as their students. They went so far as to describe an instance where they solicited students' feedback to gauge engagement and learning. Instructor I stated, “listening to that feedback helped really promote me to change how I was teaching this semester.” Although Instructor I decreased in their scores on the post-survey MAIT for conditional knowledge, planning, monitoring, and evaluating, their interview showed that they did improve in these areas of metacognition and even explicitly credited the PLC with changes in their instruction.

Instructor J. Instructor J had the most considerable negative change on the MAIT with an overall change of -0.25 points. Instructor J began with the highest score on the MAIT at the beginning of the semester. They scored 4.29 points on the pre-survey MAIT, yet decreased by -0.25 points to a score of 4.04 points on the post-survey MAIT. When compared to the pre-survey MAIT, Instructor J decreased in both the subsets of metacognitive knowledge and metacognitive regulation. The greatest difference was in their metacognitive regulation, where their average score within all three domains decreased. They decreased their average score in the subset of metacognitive knowledge for declarative and conditional knowledge yet slightly increased their procedural knowledge score by two points. Like Instructor I, these decreases in score from the pre-

to post-survey MAIT do not reflect the experiences Instructor J discussed in the post-questionnaire and semi-structured interview.

On the pre-questionnaire, Instructor J stated that they anticipated learning how to improve as an instructor. Regarding Instructor J's sentiment on the pre-questionnaire, they appeared to be open to this improvement. When asked on the pre-questionnaire, "Do you anticipate the PLC will change you in any way?" Instructor J replied, "I certainly hope it does :) By helping me understand what I can do different to be better." This statement indicates a desire for declarative and conditional knowledge, helping Instructor J become aware of their strengths and weaknesses to enhance student learning. One notable change from the pre-questionnaire to the post-questionnaire was Instructor J's answers to Question 7 and Question 8, asking how much time they spent planning and reflecting on lessons after class. On the post-questionnaire, Instructor J had a marked increase in not only the amount of time they spent planning and reflecting, but they also discussed collaborating more with other instructors. For example, on the pre-questionnaire, when asked about planning, Instructor J said, "It depends on the lesson. I would say about an hour or so and perhaps few emails with others to get their input."

In contrast, on the post-questionnaire, Instructor J wrote, "In the past few months I have spend [sic] 4-5 hours a day planning for my lessons. I collaborate with colleagues at least 2-3 hours a week." Although these statements do not shed light on which metacognitive processes Instructor J used during the time spent planning and reflecting or the quality of those processes, it does indicate a change in how Instructor J approached their instruction and collaboration.

This change was also evident as Instructor J spoke about how the PLC enabled them to compare themselves to other instructors, leading them to self-reflect and metacognitively evaluate their practices. Instructor J stated, “if I'm the only one having a problem, whatever it is, then it's me not being able to do what I'm supposed to be doing, and it's not…the student…It's definitely something about me, but I gotta change it.” Instructor J described instances during the semester where they used student feedback to alter their approach to instruction. For example, Instructor J said that the PLC got them to look at how they present materials to improve student engagement. This indicates Instructor J’s conditional knowledge since the PLC's strategies inform their pedagogy to help them select strategies that enhance student learning. During the interview, Instructor J noted that they traditionally lectured in their online courses, but then they realized they needed to do something different. They went so far as to state that their lectures were “not very good.” This evaluation of teaching demonstrates Instructor J’s metacognitive regulation. It also indicates that Instructor J used declarative knowledge to gain awareness of their areas for improvement during the PLC experience. Similar to Instructor I, Instructor J incorporated techniques from other instructors and attended other instructors’ classes, thus expanding their procedural knowledge.

Instructor J was asked about some of their answers to the post-survey MAIT, where they demonstrated a decrease in score. They rated themselves lower on many of the questions pertaining to teaching techniques. Instructor J replied by saying they thought they “got it” and had done their best with teaching but realized later they needed to improve because their teaching had been “put on the back burner” and de-prioritized. This observation demonstrates that they had an awareness of their weaknesses and were

utilizing declarative knowledge. Moreover, Instructor J's statements indicate they utilized monitoring and evaluation since they were self-assessing instructional techniques during teaching and after teaching. Instructor J described a situation where they had a problem in class with student engagement. Within this narrative, they described using metacognitive monitoring during class and even changing techniques to utilize online quiz software as formative assessment during class. In another example, Instructor J described negative student feedback in regard to their questioning techniques during class. Instructor J used evaluation to reflect upon which techniques were effective and what should be changed for the next class.

Another change in Instructor J was first noted in the post-questionnaire, where they mentioned that the PLC had an effect of changing them "to be a more compassionate instructor." Concerning their instructional strategies, Instructor J stated they thought they learned more about "how to deal with different situations" than changing their teaching. Additionally, Instructor J summarized their experience with the PLC as the following: "1. Ways to teach better 2. Be more sensitive to students and their situations 3. How collaborating with others can help me to improve not just being a better instructor but a better person!!!" Instructor J used affective language that suggested that they underwent a personal transformation during the PLC intervention. When asked about these answers on the post-questionnaire, Instructor J discussed their newfound viewpoints of equity in education. For Instructor J, conversations within the PLC also had a profound effect on their understanding of equity. Instructor J described their change in perspective, indicating they applied metacognitive regulation to instructional duties outside of teaching, such as exam policies and class policies.

Instructor K. Instructor K had the highest overall score on the post-survey MAIT with 4.67 points. They increased +0.50 points from their pre-survey MAIT score of 4.17 points. Instructor K increased their scores for both subsets of metacognitive knowledge and metacognitive regulation and increased in every domain. Instructor K had the highest overall increase in score for declarative knowledge (+4 points). On the post-survey MAIT, it should also be noted that Instructor K rated themselves a 5 "strongly agree" on each question that pertained to planning.

Instructor K's responses on the pre-questionnaire indicated that they anticipated a change in conditional knowledge, much like Instructor I. Instructor K stated that they wanted to learn "practical ways to improve both the efficiency with which…students learn and the mastery level they ultimately reach." Instructor K focused on their instructional strategies, student engagement, and working cooperatively with their colleagues and their students. These aspirations were realized in Instructor K's post-questionnaire responses, demonstrating that they had made gains in their conditional knowledge as they were able to select teaching techniques for specific tasks. Instructor K said, "The PLC has given me a broader sense of how to utilize my talents and a wider variety of 'tools' to use to engage my students, particularly in an online setting." Instructor K also modeled metacognitive planning as they stated, "I have been modifying some of the assignments that I plan for next semester, and I have been thinking of ways to modify my synchronous learning sessions to be more productive and efficient."

The semi-structured interviews gave insight into Instructor K's experience within the PLC. Instructor K expressed that they felt that they did not necessarily improve in their teaching techniques but improved in *how* to do online instruction. This discussion

gave insight into Instructor K's procedural knowledge, their awareness of which techniques to use while teaching online. It also demonstrates their conditional knowledge, allowing them to pick the best strategies for student learning. For Instructor K, the PLC also helped them move beyond applying their knowledge to instructional strategies. They applied this knowledge to planning course curriculum. For example, Instructor K mentioned that they needed to reflect upon the layout, or "structure," of a course to help students. They stated, "I think the PLC helps me understand that even though I think that structure is good, there are students who struggle with understanding the structure. And so I have to do a better job, or a more thorough job, at the beginning of the semester, making sure we focus on the structure." This statement exemplifies Instructor K's conditional knowledge, applied to the selection and layout of course content. It also demonstrates metacognitive planning since Instructor K selected the best layout of a curriculum for the course.

Many of Instructor K's statements in the semi-structured interviews were indicative of their metacognitive regulation, particularly in their planning and evaluation. Instructor K explicitly mentioned "reflecting" often during the interview and gave examples of using that reflection in their metacognitive evaluation and planning. For example, Instructor K explicitly acknowledged the impact of collaborating with others and sharing perspectives, thus enabling them to make better instructional choices. In terms of the benefits they gained from prior experiences working with others, they said they got "the chance to reflect on what I do and why I do it that way and to have other people kind of give me new ideas on how I might approach things." They noted that it made them "more intentional" in their instruction since having more information about

instruction enables them to make better decisions. Regarding the PLC, Instructor K said that "listening to other people talk about how they approach their classes and working through various issues that students have was helpful." They could compare their course to other courses, such as Anatomy & Physiology, and plan and evaluate their course design and policies. For example, Instructor K discussed the issue of accepting late work in their class, but other science courses that their students take, such as Anatomy & Physiology, do not. In terms of planning and evaluating courses and curriculum, Instructor K said,

> If I'm trying to prepare a course that can be effective and there are three different instructors, then I need to be aware of how the different instructors approach things as well…I can't just…set the course up according to my own preference. I have to be aware of other people's preferences…I think the PLC also helped me get a better understanding of, in some ways, of how the students are reacting to things…maybe reflect a little more on that.

Instructor K discussed that having time between meetings was the most impactful aspect of the PLC. It gave them time to reflect, suggesting that this time was necessary for their metacognitive evaluation and self-reflection.

Interpretation of Results of the Study

Results of the pre- and post-survey MAIT and instructor questionnaires of all 10 instructors, along with the semi-structured interviews of Instructors A, I, J, and K suggested that the context of a PLC provides a space for instructors to experience metacognitive growth. The findings presented here provide evidence that the PLC experience is meaningful and personal for participants. The PLC is a form of professional

development that fosters critical self-reflection, enhances self-regulation, and nurtures metacognitive growth.

The PLC Experience is Deeply Personal

The context in which the PLC took place was important since it provided personalized professional development to the instructors who took part in it. It was made all the more meaningful since regular meetings with all science instructors were new to the PLC participants. The PLC meetings were made all the more significant since they helped decrease isolation, especially for instructors in curricular areas like chemistry and physics, where there are fewer instructors and less opportunity for cross-disciplinary collaboration.

The PLC fostered metacognitive growth since it provided a place for people to experience personal change and growth, similar to the findings of Prytula (2012); however, what instigates that change, how it is expressed, and the degree to which it occurs varies from person to person and is deeply personal. By looking at this change through the lens of transformative learning, it stands to reason that the disorienting dilemma experienced by each instructor would vary widely. For example, Instructor H did not show a significant change on the MAIT survey, nor did they express on the post-questionnaire experiencing any significant personal change resulting from participating in the PLC. They did, however, mention that "it will take some time for me to reflect on what I have learned," suggesting that they either did not experience a profound impact of the PLC on their teaching in the one-semester timeframe of the PLC or needed more time for self-reflection, introspection and time to incorporate new strategies into their

instruction. Instructor H said that they found it helpful to discuss ideas with their peers and found the PLC positive overall.

On the other hand, Instructor E had prior experience with a PLC and was skeptical of PLCs before and after the intervention. For example, on the post-questionnaire, Instructor E said that PLCs "sound great in theory but rarely contribute to conceptual change. "Where other instructors felt the PLC was useful in exchanging ideas and techniques, Instructor E felt that the group "rarely discussed useful professional learning techniques." They did not feel that the PLC changed them in any way; yet, they commented that the MAIT survey questions made them think about assessing their teaching techniques. Still, after the intervention, Instructor E increased in metacognitive regulation and knowledge on the MAIT. Rather than being due to the PLC, their change in professional practice may have come from the MAIT itself since they said they found the survey to help them reflect. In contrast with Instructor E, Instructor J had a significant shift in worldview after discussing equity issues both inside and outside the PLC. These differences in viewpoint regarding the PLC and changes in metacognition may be attributed to the difference in worldview that each individual has, leading some aspects of the PLC to be more helpful for some than for others. For some, PLC may increase metacognition and lead to an awareness and improvement in actual instruction. It enhances professional practice by promoting equity in education, policies, or even how a course is structured. As evidenced by Instructor K's responses, other instructors may become more reflective and collaborative due to the PLC.

The PLC Fosters Metacognitive Development

The results of the pre- and post-survey MAIT confirmed that instructors vary in their metacognition, as suggested by Tanner (2012) and Zepeda et al. (2018). Within the subset of metacognitive knowledge, instructors scored the highest on the domain of declarative knowledge on the pre-survey MAIT (16.10 points) and post-survey MAIT (17.60 points), which suggested that the instructors had an awareness of their strengths and weaknesses as teachers (Balcikanli, 2011). This awareness would allow instructors to influence their performance within the classroom. Question 3 on the MAIT had one of the largest positive changes in score with an increase of +0.60 points. The significant changes in scores on questions pertaining to declarative knowledge indicated that the PLC might be a place where instructors may gain awareness of their strengths, enabling them to compensate for weaknesses in their teaching. Next was the conditional knowledge domain, with an overall average score of 15.30 points on the pre-survey MAIT and 16.10 points on the post-survey MAIT. The results suggested that instructors can select teaching techniques for specific tasks. An application of conditional knowledge that instructors may use is selecting the most effective teaching techniques for specific tasks (Balcikanli, 2011). The lowest score in the subset of metacognitive knowledge was procedural knowledge, which relates to the effective use of metacognitive strategies (Zohar & Dori, 2012) and is colloquially referred to as metacognitive skills (Zohar & Barzilai, 2013). An example of using procedural knowledge while teaching is having an awareness of one's teaching techniques during instruction (Balcikanli, 2011). It aligns with Question 5 of the MAIT ("I ask myself periodically if I meet my teaching goals while I am teaching."), one of the lowest scores on the pre-survey with an average of 3.30

points. However, after the intervention, the score on Question 5 on the MAIT increased to an average of 3.90 points. This change was one of the most significant changes in score (+0.60 points), indicating that instructors were aware of their strengths and weaknesses before the intervention and knew which techniques to use for specific tasks but were not as skilled at changing strategies during teaching. These findings support the conclusions of the study on science teacher metacognition by Mai (2015). Mai (2015) found that science teachers had strong inclinations toward metacognition and scored highest in declarative knowledge and planning. Like those of the present study, these findings suggested that science instructors were aware of their strengths and weaknesses as teachers and were adept at planning and organizing their lessons (Balcikanli, 2011; Mai, 2015).

On the pre-survey MAIT, instructors scored approximately the same on metacognitive regulation (15.13 points) as on metacognitive knowledge (15.17 points). Interestingly, the widest variation in instructor scores was within metacognitive regulation, with the lowest overall average score of 13.60 points for the evaluation domain and the highest overall average score of 16.60 points for monitoring. Schraw (1994) proposed that the two subsets of metacognition develop independently of one another. This data mirrors what Schraw (1994) suggested: adults varied the most in their metacognitive regulation and awareness, as opposed to metacognitive knowledge. Interestingly, the pre- and post-survey MAIT data suggested that instructors may be aware of their metacognitive skills, or lack thereof, but may lack the regulatory skills to make appropriate changes. It was evident in the high scores on the pre-survey MAIT for planning (15.20 points) and monitoring (16.60 points), but a low overall score on

evaluation (13.60 points). A similar trend arose on the post-survey MAIT. On the post-survey MAIT, there was less variation in scores on metacognitive regulation domains, with both planning and monitoring at approximately the same average scores (16.20 and 16.30 points, respectively). Evaluation was still the lowest score (14.10 points) out of all domains, yet it increased overall. This data suggests that the PLC intervention supported the development of metacognitive knowledge more than regulation. Specifically, it promoted the development of declarative and procedural knowledge the most, followed by conditional knowledge. The widest variation in score was within metacognitive regulation, where the planning domain increased considerably, yet monitoring decreased. This study's results aligned with what Schraw (1994) proposed because the broadest variation in instructor scores on the MAIT was in the subset of metacognitive regulation. The pre- and post-survey MAIT averages demonstrated that instructors were aware of their strengths and weaknesses. Before the intervention, instructors were not skilled at changing how they teach. Instructors were adept at planning, and the collaboration within the PLC inspired instructors to try new techniques. The context of the PLC made instructors more aware of their strengths and weaknesses and which strategies to use to benefit student learning. Instructors decreased overall in monitoring and on one questions regarding evaluation on the post-survey MAIT. The score changes suggested that instructors became more aware of their weaknesses. Instructors self-assessed more candidly and were more aware of what they did and did not do instructionally.

The PLC Fosters Critical Reflection

A decrease in score on the MAIT was not necessarily correlated with a decrease in metacognition, as demonstrated by the interviews of Instructor I and Instructor J.

Similarly, the decrease in score on the MAIT for monitoring and evaluation suggested that instructors became better at self-assessment. The MAIT was ideal for initiating a conversation regarding metacognitive teaching and stimulating reflection upon one's metacognitive teaching practices. The findings suggested that one may become more critically self-aware by becoming cognizant of one's strengths and weaknesses. Because of the highly personal nature of the metacognitive experience within the PLC, some instructors increased in score on the MAIT, while some decreased. For example, Instructor J decreased in score on the post-survey MAIT, but their post-questionnaire and interview suggested they made significant personal gains in their metacognitive knowledge and regulation. Instructor J experienced transformative learning and critical reflection regarding their compassion and sensitivity when dealing with equity issues. It can be argued that the experience of the PLC increased Instructor J's metacognition and made them more self-aware.

Instructor J's experience may be an example of the cognitive bias described by Kruger and Dunning (1999), in which one miscalibrates their skill. By improving one's skills and increasing metacognition, one paradoxically recognizes one's limitations, allowing them to recognize their strengths and weaknesses better and make changes that lead to improvement (Kruger & Dunning, 1999). Statements made by Instructor I in the semi-structured interviews also support this observation, as they recalled realizing that their instructional strategies were "lacking" as a result of the PLC. Instructor B had a similar statement on the post-questionnaire but went so far as to say they felt "incompetent" since they felt they did not have much to contribute to the meetings.

Likewise, the decreases in instructors' scores on the MAIT suggested that instructors were better able to self-assess after the PLC intervention.

On the contrary, other instructors felt validated as a result of the experience. For example, Instructor L mentioned that the PLC helped their impostor phenomenon, the belief that one is not competent, leading one not to accept their success (Zanchetta et al., 2020). Impostor phenomenon is often marked by a perfectionist complex and self-doubt (Langford, 1990). Individuals experiencing self-doubt lack a clear image of themselves (Braslow et al., 2012). This gives some insight into Instructor B's comment on the pre-questionnaire that they hoped to address their "perfectionist complex" but worried that the PLC would cause them to compare themselves to others. The validation that instructors felt as part of an inclusive group of educators may have contributed to Instructor L's change in self-efficacy. When viewed through the lens of Dweck's mindset theory, individuals with impostor phenomenon are likely to have a fixed mindset, causing an individual to view their attributes as fixed and stable and their mistakes as signs of personal failure (Dweck, 2006; Langford,1990). Interventions, such as a metacognitive experience that fosters temporary doubt about one's beliefs about themselves, can aid in more accurate self-reflection (Braslow et al., 2012; Zanchetta et al., 2020). Literature suggested that interventions, such as metacognitive training or a metacognitive experience, are necessary to foster the development of a growth mindset (Braslow et al., 2012; Zanchetta et al., 2020). The metacognitive growth and critical reflection of the PLC provide such an intervention.

Collaboration Within the PLC Enhances Self-Regulation

Monitoring, then planning, was the highest domain of metacognitive regulation on the pre-survey and post-survey MAIT. As mentioned previously, this suggested that the instructors were most skilled at planning and organizing their teaching. Evaluation, however, was the lowest scoring domain on the pre-survey MAIT. When examining the pre-questionnaire data, it appeared that regarding planning (Question 7) and evaluating (Question 8) teaching, the participants expressed a lack of time and had negative feelings of isolation. This data suggested that instructors are aware of what they should be doing but lack the time, motivation, and morale to do so. This awareness was evident in Instructor B's pre-questionnaire answer on Question 8 ("How much time do you spend reflecting on lessons after class? How is this time divided between revising the lesson and collaborating with colleagues about that lesson?"). Instructor B answered, "I rarely self reflect. At the end of a class, I often feel drained and do not have the energy to put into reflection." Similarly, on Question 8 Instructor I responded, "I have not had much time reflecting on the lesson with other colleagues."

When comparing the post-questionnaire to the pre-questionnaire, the frequency of the themes of "Isolation" and "Efficiency & Lack of Time" decreased after the intervention. Moreover, the theme of "Collaboration & Communication" increased, reflected sentiments of camaraderie and validation, and instructors changed the language they used to describe collaboration. These data suggest that the PLC provided instructors with a sense of community that helped improve morale and motivation during the semester. The teaching occupation comes with unique pressures and stresses, including isolation and low motivation (Chen & Miller, 1997; Evans, 2001; Johnson & Donaldson,

2007; Y. Zhao, 2013). The present study's findings support literature, which suggests that the PLC reduces negative feelings by reducing isolation and allowing PLC members to become more motivated (DuFour et al., 2016; Y. Zhao, 2013).

The collaborative nature of the PLC allowed educators to incorporate change into their teaching practices. In addition to the positive sense of community and the PLC's perceived helpfulness, instructors began to mention their teaching and working with each other more in the post-questionnaire when compared to the pre-questionnaire. Instructors mentioned students less in their answers less on the post-questionnaire, although, in the interviews, instructors discussed helping students as their primary motivation for improving their instruction over the semester. These results suggest that instructors began to shift their focus internally as they discussed their PLC experience.

When viewed through the lens of self-regulated learning, it becomes clear how the PLC helped foster metacognition in the instructors' teaching practices. Self-regulation is comprised of cognition, metacognition, and motivation (Zohar & Dori, 2012), and the context of the PLC helped foster each of the three components in regard to teaching. The PLC enhanced participants' knowledge of strategies through the collaborative environment, fostering the development of metacognition as it inspired and motivated instructors to enhance student learning.

Metacognition is linked to motivation, leading one to take ownership of their learning (Zull, 2011). Motivation is mentioned here since Schraw and colleagues (2006) noted that motivation shapes learning by developing metacognitive skills. It also explains how individuals understand and control their learning (Zohar & Dori, 2012). Instructor A expressed this in their semi-structured interview, where they described feeling validated

as an instructor within the PLC and, after sharing teaching techniques with other instructors, felt motivated to try new techniques in class. After receiving positive feedback from students about those techniques, they felt even more motivated to try new strategies. The qualitative data collected by the MAIT provided evidence that instructors vary in their metacognition. They were aware of their strengths and weaknesses, but the PLC helped them to self-assess more accurately. Instructors were proficient at planning their instruction but were not as skilled at knowing when and how to change their teaching. The PLC provided a place to collaborate, decrease isolation, and receive inspiration to make instructional changes. Student feedback gave instructors more motivation and opportunity for professional learning and reflection. This motivation helps explain how metacognition allowed instructors to critically self-examine and self-reflect upon their teaching practices and enter into a reflection and action cycle. Figure 4.1 demonstrates the cycle of reflection which took place within the PLC. The combination of the quantitative and qualitative data suggests that instructors benefit from PLCs to self-regulate their teaching, leading them to become more motivated, less isolated, and more willing to utilize new teaching strategies and think metacognitively about their teaching.

Conclusion

This chapter examined the findings of the research question, "How can the implementation of a Professional Learning Community by college science instructors support the development of metacognitive teaching?" The present study examined the PLC as a form of metacognitive professional development to answer the research

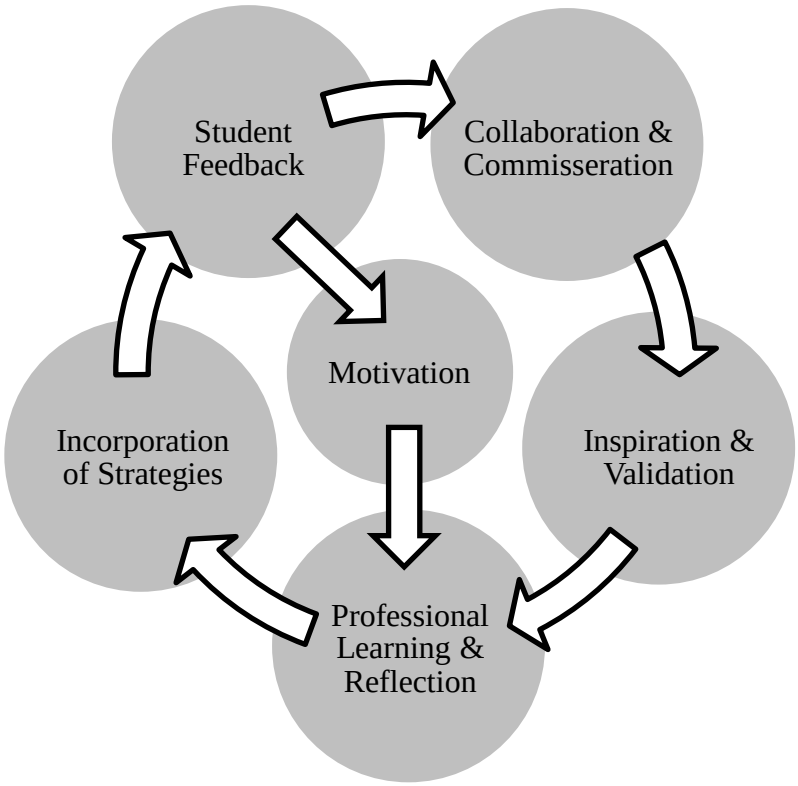


Figure 4.1. The reflection cycle within the PLC.

question, taking the form of an educative model as described by Duffy et al. (2009), in which instructors had control over the dynamic content within the PLC over a period of months. Educators were equal participants in the PLC, making it ideal for metacognitive professional development (DuFour et al., 2016). Previous studies provided evidence that both new and experienced educators benefit from professional development that expands metacognitive strategies (Prytula, 2012; Seraphin et al., 2012). This study adds to the growing body of evidence that demonstrates that the PLC, as a form of faculty professional development, benefits educators in learning metacognitive strategies and supports metacognitive growth. Similar to the study by Prytula (2012), findings support that the PLC is an ideal environment for fostering metacognition in teaching. Transformational learning theory helps explain how the PLC assists in changing

worldview and motivates instructors to incorporate metacognitive strategies into their teaching (Servage, 2008). Transformative learning is inherently metacognitive because one must engage in critical self-reflection and self-evaluation, which requires metacognition (Dix, 2016; Lonie & Desai, 2015; Mezirow, 2003). The context of the PLC is an example of an environment that assists participants in transformative learning (Servage, 2008).

Overall, the results demonstrated that the PLC context during a 15-week semester supported the development of instructor metacognition. The PLC provided personalized professional development, making it meaningful to those involved. It was a place for instructors to experience personal change and growth, thus fostering metacognition. Because of the deeply personal nature of the change experienced by participants, the PLC had varying effects among the instructors. Overall, completing the MAIT and initiation of the PLC to spur initial discussion was beneficial to instructors. 10 of the 11 PLC participants exhibited gains in metacognitive knowledge, metacognitive regulation, or both. Although one instructor decreased in both subsets of metacognition and three instructors decreased in their overall score on the MAIT, the qualitative data suggested that they still made metacognitive gains due to the PLC intervention.

As measured by the MAIT, the greatest change in metacognition was in metacognitive knowledge, signifying that the PLC helped instructors become more aware of their knowledge. Metacognitive knowledge involves knowing which strategy to use for a given task, when each strategy should be used, and how effective it is (Schraw & Dennison, 1994). In terms of teaching metacognitively, this involves having an awareness

of one's strengths and weaknesses, an awareness of the techniques used while teaching, and the selection of strategies to enhance student learning (Balcikanli, 2011).

The qualitative data results suggested that the PLC provided an environment that fostered metacognitive growth by reducing feelings of isolation and improving communication and collaboration. As a result, instructors could reflect upon their instructional strategies and feel validated and motivated to try new teaching techniques. The combination of quantitative and qualitative data determined the impact of the PLC on technical college science instructors. Before the intervention, instructors were aware of their strengths and weaknesses, but they were not skilled at changing how they taught. The collaboration within the PLC inspired instructors to try new techniques, gave them validation regarding their current instructional strategies, and allowed them to self-assess more accurately. The PLC stimulated participants to critically self-reflect. For one instructor, the PLC led to significant introspection and evaluation of issues of equity in education. For some instructors, the PLC was a metacognitive intervention that helped mitigate self-doubt. For others, it helped them to better recognize their strengths and weaknesses to make changes that led to improvements. These improvements varied from instructional changes, communication, and improvement in curricular planning. The data suggested that by learning to critically self-reflect and utilize metacognition, instructors were able to more accurately assess their skills. Some instructors made statements on the instructor questionnaires or in the semi-structured interviews that revealed metacognitive growth, despite decreasing in score on the post-survey MAIT. Other instructors expressed that they experienced validation and confirmation of their teaching skill that led to more

confidence. These results aligned with the cognitive bias described by Kruger and Dunning (1999), whereby improving metacognition, one is able to better self-assess.

The data collected served to continue the action research cycle and drove collaboration between instructors to support student success. The action research cycle allowed the participant-researcher and research participants to plan, implement, analyze, and reflect upon their PLC involvement while developing their metacognition. Throughout the semester, instructors could customize their professional development by selecting discussion topics that were meaningful to them and revolved around the most current and pressing issues. From meeting to meeting, educators in the PLC collaborated in a cyclical process of inquiry with the ultimate goal of improving student learning. While the participant-researcher initiated the action research spiral, reflection with the research participants led to the formation of the next PLC planning stages. This cycle of planning, acting, and reflecting is vital for continuing the action research cycle (Mertler, 2016) and making the PLC meaningful within the context of the study.

CHAPTER 5

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

In this study, 10 technical college science instructors and the participant-researcher formed a Professional Learning Community (PLC). The PLC served as an intervention to aid the instructors in the development of metacognitive teaching. The participant-researcher analyzed the effects of the PLC on instructor metacognition using the Metacognitive Awareness Inventory for Teachers (MAIT). This chapter discusses the conclusions of the study and recommendations gleaned from the data collected.

The Problem of Practice examined in this mixed-methods action research study is that instructors at Suburban Technical College (STC), pseudonym, are content experts who may not apply metacognition to their teaching. Individuals vary in their metacognition, which extends to the metacognitive approach of instructors (Tanner 2012; Zepeda et al., 2019). Without the utilization of metacognitive teaching practices, instructors may not know what or how to improve their instruction. It may also limit their ability to evaluate their instruction and student learning.

Instructors at STC may have practical experience in industry; yet, they may enter the teaching profession with little to no training in education. Professional development opportunities at STC are limited; campus-wide professional development is often focused on new technologies or college procedures and policies. In the past, the STC science instructors have tried to enhance their professional practice independently. Faculty professional development aids educators in learning metacognitive strategies (Seraphin et

al., 2012), and the PLC may be an environment that supports both professional development and metacognitive growth (Prytula, 2012). Given the transition to online learning and teleworking due to the COVID-19 pandemic, a PLC was the ideal venue for promoting collaboration and professional learning. The PLC was novel to the research setting, as were cross-disciplinary, department-wide meetings focused on teaching and student learning. This study investigated how the collaborative environment of the PLC impacted the development of metacognitive teaching practices by 10 technical college science instructors and the participant-researcher.

Research Question

The research question investigated to address the purpose of the study and examine the Problem of Practice was the following:

> How can the implementation of a Professional Learning Community (PLC) by college science instructors support the development of metacognitive teaching?

Purpose of Study

The purpose of this study was to examine how a PLC impacted the development of metacognitive teaching of 10 technical college science instructors. The literature suggested that instructors differ in their application of metacognition to teaching and may vary in their metacognitive ability (Tanner, 2012). Moreover, the teaching profession may be insulated, leading instructors to function in isolation (Chen & Miller, 1997). In conjunction, instructors may be resistant to change (Evans, 2001) and lack opportunities for feedback and reflection within meaningful professional development. Combining these elements may lead instructors to miscalculate their pedagogical skill level, instructional quality, and student engagement.

Although PLCs are common in lower levels of education, they have been slow to move to the post-secondary level. Research regarding PLCs in two-year and four-year colleges and universities is scarce, and research in the context of two-year technical colleges is rare. A gap in the literature exists regarding the metacognition of instructors in post-secondary education. There is a wealth of knowledge demonstrating the importance of metacognition in students at all levels of education because it enhances student learning (Cummings, 2015; Ku & Ho, 2010; Maclellan & Soden, 2012; Mytkowicz et al., 2014; Pelton, 2014; Rezvan et al., 2006; Tanner, 2012; Zohar & David, 2008). Despite a lack of knowledge on the subject, research suggests that educators must possess metacognition and be aware of their abilities to help students improve their metacognitive skills and support student learning (Kallio et al., 2017; Tanner, 2012). This study investigated instructor use of metacognition before and after implementing a PLC as an intervention to determine how the PLC promoted the development of metacognitive teaching. The participant-researcher and PLC participants examined their experiences within the PLC. The ultimate goal of this study was to learn about the impact of the PLC on college science instructors as they developed metacognitive teaching strategies.

Overview of Study

The Problem of Practice was studied using a mixed-methods action research methodology. The participant-researcher worked with 10 other technical college science instructors to form and implement a PLC at the college. The action research methodology enabled participants to control their professional growth and connect theory to practice in a personal and meaningful way (Mertler, 2016). Action research was an ideal approach to empower participants and foster change within their local setting (Efron & Ravid, 2013;

Mertler, 2016). The merging of a PLC with action research was ideal because educators in a PLC collaborate in a cycle of action research and inquiry to improve student learning (DuFour et al., 2008; Mertler, 2016). This synthesis empowered participants to better their teaching practice and afforded them the opportunity to tailor professional development to their unique circumstances (Mertler, 2016).

Overview of Methodology

The PLC was used as an intervention to foster metacognitive growth. During Week 1 of the semester, the participant-researcher and instructor participants completed the Metacognitive Awareness Inventory for Teachers (MAIT) as a pre-survey and filled out a pre-questionnaire. Instructors met six times during the semester and used the initial results of the MAIT and pre-questionnaires to spur initial discussions within the PLC. After the first PLC meeting, the topics of discussion were largely participant-led. Participants met virtually six times during the semester. During Week 14 of the semester, after the intervention, instructors completed a post-survey MAIT and post-questionnaire. As measured by a change in score on the MAIT, instructors showing the greatest and least metacognitive gain were selected for semi-structured interviews.

The data collected was analyzed by the participant-researcher before being shared with the research participants. Quantitative data from the MAIT surveys were analyzed using descriptive statistics. Qualitative data from the instructor questionnaires and semi-structured interviews were analyzed using qualitative data analysis methods. Qualitative data were analyzed by applying a coding scheme and evaluated for patterns that emerged. The mixed-methods methodology was necessary to use quantitative MAIT survey data as an initial discussion topic and select instructors for interview. The qualitative data was

essential for understanding the meaning behind instructor responses on the MAIT. This data was of vital importance for reflecting the reality of the research context and participants and comprehending how the implementation of the PLC affected the metacognitive growth of the instructors participating in the intervention.

Major Findings and Results

The major findings of the study indicated that the PLC had a positive impact on the instructors participating, and the PLC provided a place where instructors experienced personal change and metacognitive growth. The post-survey MAIT revealed that three instructors scored lower after the intervention. The MAIT data suggested that instructors varied in their metacognition, with the most variance in the subset of metacognitive regulation. Overall, the PLC promoted the development of metacognitive knowledge more than metacognitive regulation, specifically in the monitoring domain. Instructors had an awareness of their strengths and weaknesses, which increased after the PLC intervention. The increased awareness allowed instructors to change their classroom performance. According to MAIT data, instructors improved in their ability to select techniques for specific tasks. Moreover, after the PLC, instructors were more capable of changing strategies during teaching. The MAIT data suggested that instructors were aware of their metacognitive skill levels but lacked the regulatory skills to make changes. By the end of the study, the score changes on the MAIT indicated that instructors became more aware of their weaknesses, improved their self-assessment, and became more aware of what they did instructionally. These conclusions also were informed by the qualitative data.

Qualitative data from the instructor questionnaires and semi-structured interviews provided insight into the meaning of the quantitative data from the MAIT. Coding analysis of the instructor questionnaires and semi-structured interviews indicated that a decrease in score on the MAIT was not necessarily correlated with a decrease in metacognition. On the contrary, data suggested that instructors became better at self-assessment, leading to a decrease in MAIT score. The data analysis, informed by the lens of the theoretical framework, suggested that some instructors experienced a miscalibration of skills, as shown by the pre-survey MAIT and qualitative data. As instructors underwent metacognitive growth and improved in their ability to recognize their strengths and weaknesses, they were able to paradoxically recognize their own limitations, thus leading them to make instructional improvements. This metacognitive growth also led to more critical self-reflection, allowing instructors to candidly evaluate themselves. On the contrary, some instructors experienced an increase in self-efficacy; the PLC experience and their metacognitive growth enabled them to more accurately assess their skill level, leading to more confidence.

The PLC fostered critical self-reflection among participants. The collaborative nature of the PLC helped participants feel less isolated and a feeling of commiseration, which led them to implement new strategies into their professional practice. Within the instructor questionnaires, the frequency of themes relating to “Isolation” and “Efficiency & Lack of Time” decreased, while themes relating to “Collaboration & Communication” increased. Furthermore, the language that instructors used to describe their perceptions and experiences changed; they talked about themselves more and focused on collaboration, validation, and working as a “group” or “team.”

Semi-structured interviews provided triangulation and insight into the metacognitive growth of the two instructors making the greatest gains on the MAIT and the two instructors making the least gains on the MAIT. The data from the semi-structured interviews revealed the reflection cycle that occurred as a result of the PLC. The collaborative environment, combined with commiseration and reduction in isolation, led instructors to feel inspired and validated in their teaching. After a period of learning and reflecting, instructors incorporated new strategies into their teaching and professional duties. Student feedback provided motivation and opportunity for additional reflection and change. Sharing and discussing that feedback with other instructors led to more collaboration and commiseration, thus beginning the cycle again.

Overall, the qualitative findings supported the quantitative data, and they indicated that instructors found the PLC helpful. The data suggested that the PLC is a meaningful, personal experience. Because the context of the PLC is so personal, it has different effects for each individual. As a form of professional development, the PLC promotes critical self-reflection, encourages self-regulation, and supports metacognitive growth.

Action Plan

The participant-researcher shared the findings of the study with the other PLC participants. After the study took place, the science department had a new dean appointed; findings of the PLC were shared with the division dean and select others in academic leadership positions at STC. The participant-researcher will continue to share the results with other faculty members during college-wide professional development and training days to inform others of the impact of the PLC. The participant-researcher and

science instructors will persist in promoting PLCs on the STC campus to encourage other faculty to follow suit. The results of the study also were used as part of the science division goals and professional learning outcomes and were integrated into the formal review process for the college.

The action research cycle as described by Mertler (2016) was implemented during this study and beyond. During the semi-structured interviews and conversations that ensued, the instructors were overwhelmingly positive in continuing the PLC into the following semester. Although the PLC was proposed initially by the participant-researcher, the instructors asked to continue the PLC meetings beyond the context of the research study. In the following year, the participant-researcher planned to have bi-monthly PLC meetings so that the work begun within the PLC may continue. Some reasons for continuing the PLC were to "touch base as a team," "hear what other classes are doing," "connect together to solve problems," "learn effective strategies," and help the science tutoring center coordinator improve plans for student success workshops. The instructors decided to continue to lead discussions and select topics of interest within the PLC. They have made suggestions on how to improve the PLC, such as keeping topics general to all science disciplines, setting a loose agenda, and saving the last five minutes of the meeting for instructors to make announcements or accolades. The PLC also will be a place for instructors to evaluate and analyze departmental data and make decisions about common goals. The instructors, including the participant-researcher, will continue to drive the action research cycle within the PLC.

Recommendations for Practice

Based on the research findings, the participant-researcher recommends the implementation and use of PLCs to improve instructor metacognition. Triangulated data from the pre- and post-intervention MAIT, instructor questionnaires, and instructor interviews showed that metacognitive growth occurred during the intervention. The results suggested that the PLC positively impacted the PLC participants' self-regulation, self-awareness, and therefore metacognitive growth.

More specifically, the qualitative data collected from the pre- and post-questionnaires showed that the PLC allowed instructors to collaborate and commiserate more. Ultimately, the environment created by the PLC provided a place where participants were able to share and discuss strategies that individuals could later incorporate into their practice. This environment gave instructors the impetus to utilize new strategies and think metacognitively about their teaching. Based upon this data, the participant-researcher recommends instructors use the PLC to improve their professional practice and motivation.

Post-secondary educators are often isolated and work autonomously (Y. Zhao, 2013). Educators may be hesitant for others to observe or participate in their teaching and fear judgment (Johnson & Donaldson, 2007). Findings indicated that instructors of all ages, industry experience, and teaching experience benefitted from the PLC and metacognitive growth. The PLC helped to reduce instructors' feelings of isolation and inspired them to take a more active role in observing other instructors and share current student issues. As PLC participants moved from isolation to collaboration, their focus shifted. Qualitative data demonstrated that the language instructors used reflected a focus

more on themselves and the group of instructors. To help students learn effectively, instructors also must focus on their professional learning (DuFour et al., 2016). The participant-researcher recommends the PLC for improved collaboration and validation while shifting focus from the deficiencies of students to one's shortcomings and areas for improvement.

Data from the semi-structured interviews provided additional insight into instructor scores on the MAIT and instructor questionnaires. Although two instructors interviewed decreased in score on the MAIT, their metacognitive statements on the semi-structured interviews indicated that significant learning and transformation had occurred. For one instructor, there was tremendous personal growth as they reflected upon issues of equity in education. The participant-researcher recommends the PLC as a place where instructors may experience deeply personal, transformative learning. The PLC is also a forum where instructors may learn about issues of equity and social justice in education. Especially within the context of science education, teaching metacognitively promotes equity for at-risk or low-achieving students (Dang et al., 2018; White & Frederiksen, 1998). The participant-researcher suggests the fusion of the PLC and metacognitive teaching practices for student benefit and the promotion of equity in education.

Recommendations for Future Research

The present study had a sample size of 11 technical college science instructors, making the findings not generalizable; however, the data aligned with the findings of previous studies by Mai (2015), Prytula (2012), and Schraw (1994). Additionally, the majority of instructors self-identified racially as White, although the ethnic and national backgrounds of the instructors were varied. A suggestion for future research is to include

a larger number of instructors as research-participants and expand the sample to include racially diverse individuals. This change also would broaden the range of years of teaching, industry experience, and educational level. The inclusion of adjunct instructors also may more accurately reflect the overall population at STC and the southeastern county in which it is located. The larger sample size would allow for more thorough statistical analysis, given that the data is normally distributed. The impact of the PLC on instructor metacognition requires additional study with instructors at other colleges, in both the category of two-year technical and community colleges and four-year colleges and universities.

Future research should focus on addressing the limitations of the present study. Timing was an important consideration and, for research participants, the shift to more online and hybrid courses due to the COVID-19 pandemic proved problematic for instructors. Instructors had to meet virtually to adhere to the social distancing requirements of the research site. The timing of when the study took place was unprecedented and marked by more stress and isolation than normal. Additionally, instructors met six times over just one semester. Examination of the PLC's effects over an extended time would yield more knowledge and insight into the metacognitive development of instructors.

The participant-researcher focused on metacognition regarding the PLC intervention. Future research should study the impact of the PLC on other aspects of instructor change, such as a social justice orientation, self-efficacy, and isolation reduction. Each of these areas could provide a topic for potential research. Additional research could study the effects of the PLC and instructor metacognition on instructors in

other fields of general education or in technical or vocational education. Comparing the results of each study would provide a much greater understanding of how the PLC impacts professional development and metacognitive growth.

Conclusion

This action research study examined the impact of a Professional Learning Community on the metacognition of technical college science instructors. The participant-researcher measured the metacognitive awareness of the instructors acting as PLC participants before and after the PLC intervention. Instructors also completed questionnaires before and after the intervention, and instructors with the greatest and least metacognitive gains were selected for semi-structured interviews. The data collected revealed that the PLC positively influenced instructor metacognition in a deeply personal manner. The present study fills a significant gap in the literature by providing insight into the metacognition of technical college science instructors and the impact of a PLC within the context of a technical college.

The participant-researcher shared the study findings with PLC participants, colleagues at STC, and members of academic leadership to extend the use of the PLC at the college. The participant-researcher and PLC participants progressed the action research cycle by continuing the PLC. The impact of this research on the science instructors at STC extends well beyond the 15-week intervention. The results of this study indicated that many instructors experienced a shift in worldview, leading to a very personal change in how they viewed themselves as an instructor, how they viewed their students with reference to issues of equity, and how they communicated and collaborated as a team. This is perhaps the most significant finding of the present study it allowed the

participants to advance their professional practice and become more aware of how they can improve their instruction to benefit student learning.

REFERENCES

Adey, P., & Shayer, M. (1993). An exploration of long-term far-transfer effects following an extended intervention program in the high school science curriculum. *Cognition and Instruction*, *11*(1), 1–29.

Ambrose, S. A., Bridges, M. W., Dipietro, M., Lovett, M. C., & Norman, M. K. (2013). *How learning works: Seven research-based principles for smart teaching*. Jossey-Bass.

American Association for the Advancement of Science (AAAS). (2011). *Vision and change in undergraduate biology education.* American Association for the Advancement of Science. https://visionandchange.org/

Anderson, E., & Kim, D. (2006). Increasing the success of minority students in science and technology. In*American Council on Education*. American Council on Education.

Balcikanli, C. (2011). Metacognitive awareness inventory for teachers (MAIT). *Electronic Journal of Research in Educational Psychology*, *9*(3), 1309–1332.

Bartz, D. E., & Kritsonis, W. A. (2019). PreK-12 teachers as learners : How they can get the most out of professional development. *National Forum Teacher Education Journal*, *29*(3), 1–7.

Ben-David, A., & Orion, N. (2013). Teachers' voices on integrating metacognition into science education. *International Journal of Science Education*, *35*(18), 3161–3193. https://doi.org/10.1080/09500693.2012.6972

Bransford, J. D., Brown, A. L., & Cocking, R. R. (1999). *How people learn: Brain, mind, experience, and school*. National Academy Press.

Braslow, M. D., Guerrettaz, J., Arkin, R. M., & Oleson, K. C. (2012). *Self-doubt*. *6*(6), 470–482.

Bråten, I. (1991a). Vygotsky as precursor to metacognitive theory: I. The concept of metacognition and its roots. *Scandinavian Journal of Educational Research*, *35*(3), 179–192. https://doi.org/10.1080/0031383910350302

Bråten, I. (1991b). Vygotsky as precursor to metacognitive theory: II. Vygotsky as metacognitivist. *Scandinavian Journal of Educational Research*, *35*(4), 305–320. https://doi.org/10.1080/0031383910350406

Brown, A. (1987). Metacognition, executive control, self-regulation, and other more mysterious mechanisms. In F. E. Weinert & R. H. Kluwe (Eds.), *Metacognition, motivation, and understanding* (pp. 65–116). Lawrence Erlbaum Associates, Inc.

Buoncristiani, M., & Buoncristiani, P. (2012). *Developing mindful students, skillful thinkers, thoughtful schools*. Corwin.

Burk, N. M. (2000, November). Empowering at-risk students: Storytelling as a pedagogical tool [Paper Presentation]. 86th Annual Meeting of the National Communication Association, Seattle, WA. https://files.eric.ed.gov/fulltext/ED447497.pdf

Carter, D. F. (2006). Key issues in the persistence of underrepresented minority students. *New Directions for Institutional Research*, *2006*(130), 33–46. https://doi.org/10.1002/ir

Chen, M., & Miller, G. (1997). *Teacher stress: A review of the international literature*. https://mirlyn.lib.umich.edu/Record/011098589

Christie, M., Carey, M., Robertson, A., & Grainger, P. (2015). Putting transformative learning theory into practice. *Australian Journal of Adult Learning*, *55*(1), 9–30.

Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches*. SAGE Publications.

Creswell, J. W., & Plano Clark, V. L. (2018). *Designing and conducting mixed methods research* (3rd ed.). SAGE Publications.

Creswell, J. W., & Miller, D. L. (2000). Determining validity in qualitative inquiry. *Theory into Practice, 39*(3), 124–130. https://doi.org/10.1207/s15430421tip3903_2

Cummings, C. (2015). Engaging new college students in metacognition for critical thinking: A developmental education perspective. *Research & Teaching in Developmental Education*, *32*(1), 68–71.

Dang, N. V., Chiang, J. C., Brown, H. M., & McDonald, K. K. (2018). Curricular activities that promote metacognitive skills impact lower-performing students in an introductory biology course. *Journal of Microbiology & Biology Education*, *19*(1), 1–9. https://doi.org/10.1128/jmbe.v19i1.1324

Darling-Hammond, L. (1996). The quiet revolution: Rethinking teacher development. *Educational Leadership*, *53*(6), 4–10.

Dinsmore, D. L., Alexander, P. A., & Loughlin, S. M. (2008). Focusing the conceptual lens on metacognition, self-regulation, and self-regulated learning. *Educational Psychology Review*, *20*(4), 391–409. https://doi.org/10.1007/s10648-008-9083-6

Dix, M. (2016). The cognitive spectrum of transformative learning. *Journal of Transformative Education*, *14*(2), 139–162. https://doi.org/10.1177/1541344615621951

Doyle, B. (2013). *Metacognitive awareness: Impact of a metacognitive intervention in a pre-nursing course*. https://etd.lsu.edu/docs/available/etd-06252013-154139/

Duffy, G. G., Miller, S., Parson, S., & Meloth, M. (2009). Teachers as metacognitive professionals. In D. J. Hacker, J. Dunlosky, & A. C. Graesser (Eds.), *Handbook of metacognition in education*. Routledge. https://doi.org/10.1017/CBO9781107415324.004

DuFour, R., DuFour, R., & Eaker, R. (2008). *Revisiting professional learning communities at work: New insights for improving schools*. Solution Tree Press.

DuFour, R., DuFour, R., Eaker, R., Many, T. A., & Mattos, M. (2016). *Learning by doing: A handbook for professional learning communities at work* (3rd ed.). Solution Tree Press.

DuFour, R., & Eaker, R. (1998). *Professional learning communities at work: Best practices for enhancing student achievement*. Solution Tree Press.

Dunlosky, J., & Metcalfe, J. (2009). *Metacognition*. SAGE Publications.

Dunning, D., Johnson, K., Ehrlinger, J., & Kruger, J. (2003). Why people fail to recognize their own incompetence. *Current Directions in Psychological Science*, *12*(3), 83–87. https://doi.org/10.1111/1467-8721.01235

Dweck, C. S. (2006). *Mindset: The new psychology of success*. Random House.

Efklides, A. (2008). Metacognition: Defining its facets and levels of functioning in relation to self-regulation and co-regulation. *European Psychologist*, *13*(4), 277–287. https://doi.org/10.1027/1016-9040.13.4.277

Efron, S. E., & Ravid, R. (2013). *Action research in education: A practical guide*. The Guilford Press.

Ellis, A. K., Denton, D. W., & Bond, J. B. (2014). An analysis of research on metacognitive teaching strategies. *Procedia - Social and Behavioral Sciences*, *116*(February), 4015–4024. https://doi.org/10.1016/j.sbspro.2014.01.883

Evans, R. (2001). *The human side of school change: Reform, resistance, and the real-life problems of innovation.* Jossey-Bass.

Flavell, J. H. (1971). First discussant's comments: What is memory development the development of? *Human Development*, *14*(4), 272–278. https://doi.org/http://dx.doi.org/10.1159/000271221

Flavell, J. H. (1976). Metacognitive aspects of problem solving. In L. B. Resnick (Ed.), *The Nature of Intelligence* (pp. 231–235). Lawrence Erlbaum Associates, Inc.

Flavell, J. H. (1979). Metacognition and cognitive monitoring: A new area of psychological inquiry. *American Psychologist*, *34*(10), 906–911.

Flavell, J. H., Freidrichs, A. G., & Hoyt, J. D. (1970). Developmental changes in memorization processes. *Cognitive Psychology*, *1*(4), 324–340. https://doi.org/http://dx.doi.org.pallas2.tcl.sc.edu/10.1016/0010-0285(70)90019-8

Flavell, J. H., Miller, P. H., & Miller, S. A. (2002). *Cognitive development* (4th ed.). Pearson.

Fleming, S. M., & Dolan, R. J. (2012). The neural basis of metacognitive ability. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *367*, 1338–1349. https://doi.org/10.1007/978-3-642-45190-4_11

Fox, E., & Riconscente, M. (2008). Metacognition and self-regulation in James, Piaget, and Vygotsky. *Educational Psychology Review*, *20*(4), 373–389. https://doi.org/10.1007/s10648-008-9079-2

Frith, C. D. (2012). The role of metacognition in human social interactions. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *367*, 2213–2223. https://doi.org/10.1098/rstb.2012.0123

Greene, J. A., Costa, L. J., & Dellinger, K. (2011). Analysis of self-regulated learning processing using statistical models for count data. *Metacognition and Learning*, *6*(3), 275–301. https://doi.org/10.1007/s11409-011-9078-4

Hacker, D. J., Bol, L., Horgan, D. D., & Rakow, E. A. (2000). Test prediction and performance in a classroom context. *Journal of Educational Psychology*, *92*(1), 160–170. https://doi.org/10.1037/0022-0663.92.1.160

Hacker, D. J., Dunlosky, J., & Graesser, A. C. (1998). *Metacognition in educational theory and practice*. Erlbaum.

Hartman, H. (2001). Teaching metacognitively. In H. Hartman (Ed.), *Metacognition in learning and instruction: Theory, research, and practice*. Kluwer Academic Publishers. https://doi.org/10.1007/978-94-017-2243-8

Herr, K., & Anderson, G. L. (2015). *The action research dissertation*. SAGE Publications.

Holton, D., & Clarke, D. (2006). Scaffolding and metacognition. *International Journal of Mathematical Education in Science and Technology*, *37*(2), 127–143. https://doi.org/10.1080/00207390500285818

Hord, S. M. (1997). Professional learning communities: Communities of continuous inquiry and improvement. *Leadership*, *40*(1), 58–59. https://doi.org/10.1177/1365480210376487

Hord, S. M. (2008). Evolution of the professional learning community: Revolution concept is based on intentional collegial learning. *Journal of Staff Development*, *29*(3), 10–13.

Hord, S. M. (2009). Professional learning communities. *National Staff Development Council*, *30*(1), 40–43. https://doi.org/10.4324/9781315164564-3

Howard, T. C. (2010). *Why race and culture matter in schools: Closing the achievement gap in America's classrooms*. Teachers College Press.

Howie, P., & Bagnall, R. (2013). A beautiful metaphor: Transformative learning theory. *International Journal of Lifelong Education*, *32*(6), 816–836. https://doi.org/10.1080/02601370.2013.817486

Jacobs, J. E., & Paris, S. G. (1987). Children's metacognition about reading: Issues in definition, measurement, and instruction. *Educational Psychologist*, *22*(3–4), 255–278. https://doi.org/10.1207/s15326985ep2203&4_4

Johnson, S. M., & Donaldson, M. L. (2007). Overcoming the obstacles to leadership. *Educational Leadership*, *65*(1), 8013.

Kallio, H., Virta, K., & Kallio, M. (2018). Modelling the components of metacognitive awareness. *International Journal of Educational Psychology, 7*(2), 94. https://doi.org/10.17583/ijep.2018.2789

Kallio, H., Virta, K., Kallio, M., Virta, A., Hjardemaal, F. R., & Sandven, J. (2017). The utility of the metacognitive awareness inventory for teachers among in-service teachers. *Journal of Education and Learning*, *6*(4), 78–91. https://doi.org/10.5539/jel.v6n4p78

Kamler, B., & Comber, B. (2005). Turn-around pedagogies: Improving the education of at-risk students. *Improving Schools*, *8*(2), 121–131. https://doi.org/10.1177/1365480205057702

Kramarski, B., Mevarech, Z. R., & Arami, M. (2002). The effects of metacognitive instruction on solving mathematical authentic tasks. *Educational Studies in Mathematics*, *103*(3), 239–248. https://doi.org/10.1023/A:1016282811724

Kramarski, B., & Michalsky, T. (2009). Investigating preservice teachers' professional growth in self-regulated learning environments. *Journal of Educational Psychology*, *101*, 161–175.

Kruger, J., & Dunning, D. (1999). Unskilled and unaware of it: How differences in recognizing one's own incompetence lead to inflated self-assessments. *Journal of Personality and Social Psychology*, *77*(6), 1121–1134. https://doi.org/10.1037//0022-3514.77.6.1121

Kruse, S., Seashore Louis, K., & Bryk, A. (1994). Building professional community in schools. *Issues in Restructuring Schools*. https://www.wcer.wisc.edu/archive/cors/issues_in_Restructuring_Schools/issues_NO_6_SPRING_1994.pdf

Ku, K. Y. L., & Ho, I. T. (2010). Metacognitive strategies that enhance critical thinking. *Metacognition and Learning*, *5*(3), 251–267. https://doi.org/10.1007/s11409-010-9060-6

Kuhn, D. (2000). Metacognitive development. *Current Directions in Psychological Science*, *9*(5), 178–181.

Kuhn, D., & Pearsall, S. (1998). Relations between metastrategic knowledge and strategic performance. *Cognitive Development*, *13*(2), 227–247. https://doi.org/10.1016/S0885-2014(98)90040-5

Langford, J. (1990). The need to look smart: The impostor phenomenon and motivations for learning. In *Preventing School Failure 51*(3). https://search.proquest.com/docview/220297257?accountid=12834

Larmar, S., & Lodge, J. M. (2014). Making sense of how I learn: Metacognitive capital and the first year university student. *The International Journal of the First Year in Higher Education*, *5*(1). https://doi.org/10.5204/intjfyhe.v5i1.193

Larson, C. B. (2009). *Metacognition: New research developments*. Nova Science Publishers, Inc.

Lemons, P. P., Reynolds, J. A., Curtin-Soydan, A. J., & Bissell, A. N. (2013). Improving critical-thinking skills in introductory biology through quality practice and metacognition. In M. Kaplan, N. Silver, D. Lavaque-Manty, & D. Meizlish (Eds.), *Using reflection and metacognition to improve student learning: Across the disciplines, across the academy*. Stylus Publishing, LLC.

Leutwyler, B. (2009). Metacognitive learning strategies: Differential development patterns in high school. *Metacognition and Learning*, *4*(2), 111–123. https://doi.org/10.1007/s11409-009-9037-5

Little, J., & McLaughlin, M. W. (1993). *Teachers' work: Individuals, colleagues, and contexts.* Teachers College Press.

Long, M. G., Cottrell-Yongye, A. M., & Huynh, T. T. (2020). Backward redesign of a nonmajors biology course at a two-year technical college. *Journal of College Science Teaching*, *49*(6), 7–16.

Lonie, J. M., & Desai, K. R. (2015). Using transformative learning theory to develop metacognitive and self-reflective skills in pharmacy students: A primer for pharmacy educators. *Currents in Pharmacy Teaching and Learning*, *7*(5), 669–675. https://doi.org/10.1016/j.cptl.2015.06.002

Lorah, J., & Ndum, E. (2013). Trends in achievement gaps in first-year college courses for racial/ethnic, income, and gender subgroups: A 12-year study. In *ACT, Inc.*

Machi, L. A., & McEvoy, B. T. (2016). *The literature review: Six steps to success* (3rd ed.). SAGE Publications.

Maclellan, E., & Soden, R. (2012). Psychological knowledge for teaching critical thinking: The agency of epistemic activity, metacognitive regulative behaviour and (student-centred) learning. *Instructional Science*, *40*(3), 445–460. https://doi.org/10.1007/s11251-011-9183-4

Maggioni, L., & Parkinson, M. M. (2008). The role of teacher epistemic cognition, epistemic beliefs, and calibration in instruction. *Educational Psychology Review*, *20*(4), 445–461.

Mai, M. Y. (2015). Science teachers self perception about metacognition. *Journal of Educational and Social Research*, *5*(1), 77–86. https://doi.org/10.5901/jesr.2015.v5n1s1p77

Mangrum, J. (2019). *Metacognitive Learning and the First-Year Student*. [Masters thesis, Kennesaw State University]. Kennesaw State University digital commons. https://digitalcommons.kennesaw.edu/cgi/viewcontent.cgi?article=1010&context=msfys_etd

Martinez, B. Y. M. E. (2006). What Is metacognition? *Phi Delta Kappan*, *87*(9), 696–699.

McLaughlin, M. W., & Talbert, J. E. (1993). Contexts that matter for teaching and learning: Strategic opportunities for meeting the nation's educational goals. Stanford University Center for Research on the Context of Secondary School Teaching. https://www.researchgate.net/publication/277743753_Contexts_That_Matter_for_Teaching_and_Learning_Strategic_Opportunities_for_Meeting_the_Nation%27s_Educational_Goals

Merriam, S. B., & Tisdell, E. J. (2016). *Qualitative research: A guide to design and implementation* (4th ed.). Jossey-Bass.

Mertler, C. A. (2016). *Action research: Improving schools and empowering educators* (5th ed.). SAGE Publications.

Mezirow, J. (1981). A critical theory of adult learning and education. *Adult Education*, *32*, 3–24.

Mezirow, J. (1991). *Transformative dimensions of adult learning*. Jossey-Bass.

Mezirow, J. (1997). Transformative learning: Theory to practice. *New Directions for Adult and Continuing Education*, *74*, 5–12. https://doi.org/10.1002/ace.7401

Mezirow, J. (2000). *Learning as transformation: Critical perspectives on a theory in progress*. Jossey-Bass.

Mezirow, J. (2003). Transformative learning as discourse. *Journal of Transformative Education*, *1*(1), 58–63. https://doi.org/10.1177/1541344603252172

Mezirow, J., & Taylor, E. W. (2009). *Transformative learning in practice*. Jossey-Bass.

Minbiole, J. (2016). Improving course coherence & assessment rigor: "Understanding by Design" in a nonmajors biology course. *The American Biology Teacher*, *78*(6), 463–470. https://doi.org/10.1525/abt.2016.78.6.463

Mytkowicz, P., Goss, D., & Steinberg, B. (2014). Assessing metacognition as a learning outcome in a postsecondary strategic learning course. *Journal of Postsecondary Education and Disability*, *27*(1), 51–62.

Newmann, F., & Wehlage, G. (1995). *Successful school restructuring: A report to the public and educators by the center for restructuring schools*. University of Wisconsin Press.

Noushad, P. P. (2008). *Cognitions about cognitions: The theory of metacognition*. https://eric.ed.gov/?id=ED502151

Novak, J. D. (1990). Concept maps and Vee diagrams: Two metacognitive tools to facilitate meaningful learning. *Instructional Science*, *19*, 29–52.

Osterhage, J. L., Usher, E. L., Douin, T. A., & Bailey, W. M. (2019). Opportunities for self-evaluation increases student calibration in an introductory biology course. *CBE - Life Sciences Education*, *18*(2), 1–10. https://doi.org/10.1187/cbe.18-10-0202

Packard, B. W., & Babineau, M. E. (2009). From drafter to engineer, doctor to nurse: An examination of career compromise as renegotiated by working-class adults over time. *Journal of Career Development*, *35*(3), 207–227. https://doi.org/10.1177/0894845308327270

Parker, J., & Heywood, D. (2013). Exploring how engaging with reflection on learning generates pedagogical insight in science teacher education. *Science Education*, *97*(3), 410–441. https://doi.org/10.1002/sce.21049

Parsons, R. D., & Brown, K. S. (2002). *Teacher as reflective practitioner and action researcher*. Wadsworth/Thomson Learning.

Pelton, J. A. (2014). How our majors believe they learn: Student learning strategies in an undergraduate theory course. *Teaching Sociology*, *42*(4), 277–286. https://doi.org/10.1177/0092055X14542351

Pennequin, V., Sorel, O., Nanty, I., & Fontaine, R. (2010). Metacognition and low achievement in mathematics: The effect of training in the use of metacognitive skills to solve mathematical word problems. *Thinking and Reasoning*, *16*(3), 198–220. https://doi.org/10.1080/13546783.2010.509052

Piaget, J. (1970). *Science of education and the psychology of the child*. Orion Press.

Pintrich, P. R. (2000). The role of goal orientation in self-regulated Learning. In M. Zeidner, P. R. Pintrich, & M. Boekaerts (Eds.), *Handbook of self-regulation* (pp. 451–529). Academic Press. https://doi.org/10.1016/B978-012109890-2/50043-3

Pintrich, P. R. (2002). The role of metacognitive knowledge in learning, teaching, and assessing. *Theory Into Practice*, *41*(4), 119–225.

Pressley, M., & Harris, K. R. (2017). Cognitive strategies instruction: From basic research to classroom instruction. *Journal of Education*, *189*(1–2), 77–94. https://doi.org/10.1177/0022057409189001-206

Prytula, M. P. (2012). Teacher metacognition within the professional learning community. *International Education Studies*, *5*(4), 112–121. https://doi.org/10.5539/ies.v5n4p112

Qiu, L., Su, J., Ni, Y., Bai, Y., Zhang, X., Li, X., & Wan, X. (2018). The neural system of metacognition accompanying decision-making in the prefrontal cortex. *PLoS Biology*, *16*(4), 1–27. https://doi.org/10.1371/journal.pbio.2004037

Rezvan, S., Ahmadi, S. A., & Abedi, M. R. (2006). The effects of metacognitive training on the academic achievement and happiness of Esfahan University conditional students. *Counselling Psychology Quarterly*, *19*(4), 415–428. https://doi.org/10.1080/09515070601106471

Richter, T., & Schmid, S. (2010). Epistemological beliefs and epistemic strategies in self-regulated learning. *Metacognition and Learning*, *5*(1), 47–65. https://doi.org/10.1007/s11409-009-9038-4

Rinehart, S. D., & Platt, J. M. (1984). Metacognitive awareness and monitoring in adult and college readers. *Forum for Reading, 15*(2), 54–62.

Rosenholtz, S. (1989). *Teacher's workplace: The social organization of schools.* Longman.

Schraw, G. (1994). The effect of metacognitive knowledge on local and global monitoring. *Contemporary Educational Psychology*, *19*(2), 143–154. https://doi.org/10.1006/ceps.1994.1013

Schraw, G. (1998). Promoting general metacognitive awareness. *Instructional Science2*, *26*(1–2), 113–125.

Schraw, G., Crippen, K. J., & Hartley, K. (2006). Promoting self-regulation in science education: Metacognition as part of a broader perspective on learning. *Research in Science Education*, *36*(1–2), 111–139. https://doi.org/10.1007/s11165-005-3917-8

Schraw, G., & Dennison, R. S. (1994). Assessing metacognitive awareness. *Contemporary Educational Psychology*, *19*(4), 460–475.

Schraw, G., & Moshman, D. (1995). Metacognitive theories. *Educational Psychology Review*, *7*(4), 351–371.

Senge, P. M. (1990). *The fifth discipline: The art and practice of learning organization*. Doubleday.

Senge, P. M. (2012). *Schools that learn: A fifth discipline fieldbook for educators, parents, and everyone who cares about education*. Crown Publishing Group.

Seraphin, K., Philippoff, J., Kaupp, L., & Vallin, L. M. (2012). Metacognition as means to increase the effectiveness of inquiry-based science education. *Science Education International*, *23*(4), 366–382.

Servage, L. (2008). *Critical & transformative practices* in professional learning communities. Teacher Education Quarterly, 35, 63-77. https://files.eric.ed.gov/fulltext/EJ810651.pdf

Shannon, H. D., & Smith, R. C. (2006). A case for the community college's open access mission. *New Directions for Community Colleges*, *2006*(136), 15–21. https://doi.org/10.1002/cc.255

Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher*, *15*(2), 4–14.

Silver, N. (2013). Reflective pedagogies and the metacognitive turn in college teaching. In M. Kaplan, N. Silver, D. LaVaque-Manty, & D. Meizlish (Eds.), *Using reflection and metacognition to improve student learning: Across the disciplines, across the academy*. Stylus Publishing, LLC.

Smith, J. L., & Vellani, F. A. (1999). Urban America and the community college imperitive: The importance of open access and opportunity. *New Directions for Community Colleges*, *1999*(107), 5–13. https://doi.org/10.1002/cc.10701

Smith, K. S., Rook, J. E., & Smith, T. W. (2007). *Effective and metacognitive writing strategies in content areas, 51*(3), 43-48. https://doi.org/10.3200/PSFL.51.3.43-48

Sperling, R. A., Howard, B. C., Staley, R., & DuBois, N. (2004). Metacognition and self-regulated learning constructs. *Educational Research and Evaluation*, *10*(2), 117–139.

Tanner, K. D. (2012). Promoting student metacognition. *CBE Life Sciences Education*, *11*(2), 113–120. https://doi.org/10.1187/cbe.12-03-0033

Thomas, G. P., & Anderson, D. (2014). Changing the metacognitive orientation of a classroom environment to enhance students' metacognition regarding chemistry learning. *Learning Environments Research*, *17*(1), 139–155. https://doi.org/10.1007/s10984-013-9153-7

Vermunt, J. D., & Verloop, N. (1999). Congruence and friction between learning and teaching. *Learning and Instruction*, *9*, 257–280.

von Wright, J. (1992). Reflections on reflection. *Learning and Instruction*, *2*(1), 59–68. https://dx.doi.org.pallas2.tcl.sc.edu/10.1016/0959-4752(92)90005-7

Wang, M. C., Haertel, G. D., & Walberg, H. J. (1990). What influences learning? A content analysis of review literature. *Journal of Educational Research*, *84*(1), 30–43.

Whimbey, A. (1980). Students can learn to be better problem solvers. *Educational Leadership1*, *37*(7), 560–565.

White, B. Y., Frederiksen, J., & Collins, A. (2009). The interplay of scientific inquiry and metacognition: More than a marriage of convenience. *Handbook of Metacognition in Education, January 2009*, 175–205.

White, B. Y., & Frederiksen, J. R. (1998). Inquiry, modeling, and metacognition: Making science accessible to all students. *Cognition and Instruction1*, *16*(1), 113–118. https://doi.org/10.1207/s1532690xci1601_2

Wilson, D., & Conyers, M. (2013). *Five big ideas for effective teaching: Connecting mind, brain, and education research to classroom practice.* Teachers College Press.

Wilson, R. E., & Kittleson, J. (2013). Science as a classed and gendered endeavor: Persistence of two white female first-generation college students within an

undergraduate science context. *Journal of Research in Science Teaching*, *50*(7), 802–825. https://doi.org/10.1002/tea.21087

Winne, P. H., & Nesbit, J. C. (2010). The psychology of academic achievement. *Annual Review of Psychology*, *61*(1), 653–678. https://doi.org/10.1146/annurev.psych.093008.100348

Young, A., & Fry, J. D. (2008). Metacognitive awareness and academic achievement in college students. *Journal of the Scholarship of Teaching and Learning*, *8*(2), 1–10. https://doi.org/10.3109/0142159X.2010.487711

Zanchetta, M., Junker, S., Wolf, A. M., & Traut-Mattausch, E. (2020). "Overcoming the fear that haunts your success" – The effectiveness of interventions for reducing the impostor phenomenon. *Frontiers in Psychology*, *11*, 1–15. https://doi.org/10.3389/fpsyg.2020.00405

Zepeda, C. D., Hlutkowsky, C. O., Partika, A. C., & Nokes-Malach, T. J. (2018). Identifying teachers' supports of metacognition through classroom talk and its relation to growth in conceptual learning. *Journal of Educational Psychology*, *111*(3), 522–541. https://doi.org/10.1037/edu0000300

Zhao, N., Wardeska, J., McGuire, S., & Cook, E. (2014). Metacognition: An effective tool to promote success in college science learning. *Journal of College Science Teaching*, *043*(04), 48–54. https://doi.org/10.2505/4/jcst14_043_04_48

Zhao, Y. (2013). Professional learning community and college English teachers' professional development. *Journal of Language Teaching and Research*, *4*(6), 1365–1370.

Zimmerman, B. J. (2002). Becoming a self-regulated learner: An overview. *Theory Into Practice, 41*(2), 64–70. https://doi.org/10.1207/s15430421tip4102_2

Zohar, A., & Barzilai, S. (2013). A review of research on metacognition in science education: current and future directions. *Studies in Science Education, 49*(2), 121–169. https://doi.org/10.1080/03057267.2013.847261

Zohar, A., & David, A. B. (2008). Explicit teaching of meta-strategic knowledge in authentic classroom situations. *Metacognition and Learning, 3*(1), 59–82. https://doi.org/10.1007/s11409-007-9019-4

Zohar, A., & Dori, Y. J. (2012). Metacognition in science education: Trends in current research. In *Contemporary Trends and Issues in Science Education* (Vol. 40). https://doi.org/10.1017/CBO9781107415324.004

Zull, J. E. (2011). *From brain to mind: Using neuroscience to guide change in education*. Stylus Publishing, LLC.

APPENDIX A

THE METACOGNITIVE AWARENESS INVENTORY FOR TEACHERS

The following inventory was originally published by Balcikanli (2011).

The analysis of the inventory was created and adapted to facilitate discussion within the Professional Learning Community.

Read each statement carefully and choose which statements are true for you. There are no right or wrong answers.

1= Strongly Disagree 2= Disagree 3= Neutral 4= Agree 5= Strongly Agree

1. I am aware of the strengths and weaknesses in my teaching.	1 2 3 4 5
2. I try to use teaching techniques that worked in the past.	1 2 3 4 5
3. I use my strengths to compensate for my weaknesses in my teaching.	1 2 3 4 5
4. I pace myself while I am teaching in order to have enough time.	1 2 3 4 5
5. I ask myself periodically if I meet my teaching goals while I am teaching.	1 2 3 4 5
6. I ask myself how well I have accomplished my teaching goals once I am finished.	1 2 3 4 5
7. I know what skills are most important in order to be a good teacher.	1 2 3 4 5
8. I have a specific reason for choosing each teaching technique I use in class.	1 2 3 4 5
9. I can motivate myself to teach when I really need to teach.	1 2 3 4 5
10. I set my specific teaching goals before I start teaching.	1 2 3 4 5
11. I find myself assessing how useful my teaching techniques are while I am teaching.	1 2 3 4 5
12. I ask myself if I could have used different techniques after each teaching experience.	1 2 3 4 5
13. I have control over how well I teach.	1 2 3 4 5
14. I am aware of what teaching techniques I use while I am teaching.	1 2 3 4 5
15. I use different teaching techniques depending on the situation.	1 2 3 4 5
16. I ask myself questions about the teaching materials I am going to use.	1 2 3 4 5

17. I check regularly to what extent my students comprehend the topic while I am teaching.	1 2 3 4 5
18. After teaching a point, I ask myself if I'd teach it more effectively next time.	1 2 3 4 5
19. I know what I am expected to teach.	1 2 3 4 5
20. I use helpful teaching techniques automatically.	1 2 3 4 5
21. I know when each teaching technique I use will be most effective.	1 2 3 4 5
22. I organize my time to best accomplish my teaching goals.	1 2 3 4 5
23. I ask myself questions about how well I am doing while I am teaching.	1 2 3 4 5
24. I ask myself if I have considered all possible techniques after teaching a point.	1 2 3 4 5

MAIT Scoring Guide

Add the scores from each question to determine your total score for each factor. The closer the score is to '20' the more you use each metacognitive factor.

	Total Score	Factor
1. _____ + 2. _____ + 3. _____ + 4. _____		Declarative Knowledge
5. _____ + 6. _____ + 7. _____ + 8. _____		Procedural Knowledge
9. _____ + 10. _____ + 11. _____ + 12. _____		Conditional Knowledge
13. _____ + 14. _____ + 15. _____ + 16. _____		Planning
17. _____ + 18. _____ + 19. _____ + 20. _____		Monitoring
21. _____ + 22. _____ + 23. _____ + 24. _____		Evaluating

Declarative Knowledge = knowing about things (Schraw & Moshman, 1995).

Procedural Knowledge = knowing how to do things (Schraw & Moshman, 1995).

Conditional Knowledge = knowing why and when to do things (Schraw & Moshman, 1995).

Planning = "the selection of appropriate strategies and the allocation of resources that affect one's learning performance" (Schraw & Moshman, 1995, p. 354).

Monitoring = "one's online awareness of comprehension and task performance" (Schraw & Moshman, 1995, p. 355).

Evaluating = "appraising the products and regulatory processes of one's learning" (Schraw & Moshman, 1995, p. 355).

APPENDIX B

INSTRUCTOR QUESTIONNAIRES

Pre-Intervention Questionnaire

1. What do you understand to be the definition of a Professional Learning Community (PLC)?

2. What perceptions do you currently have about PLCs?

3. What do you anticipate learning by participating in the PLC?

4. Have you ever participated in a PLC before? If so, what was your experience like?

5. Do you anticipate that the PLC will change you in any way? How or why?

6. How do you anticipate your instructional strategies will change as you take part in the PLC?

7. How much time do you spend planning lessons before class? How is this time divided between designing the lesson and collaborating with colleagues about that lesson?

8. How much time do you spend reflecting on lessons after class? How is this time divided between revising the lesson and collaborating with colleagues about that lesson?

Post-Intervention Questionnaire

1. What do you understand to be the definition of a Professional Learning Community (PLC)?

2. What perceptions do you currently have about PLCs?

3. What did you learn by taking part in the PLC?

4. Now that you have participated in a PLC, how would you summarize your experience?

5. Has the PLC changed you in any way? How or why?

6. How have your instructional strategies changed as a result of taking part in the PLC?

7. How much time do you spend planning lessons before class? How is this time divided between designing the lesson and collaborating with colleagues about that lesson?

8. How much time do you spend reflecting on lessons after class? How is this time divided between revising the lesson and collaborating with colleagues about that lesson?

APPENDIX C

SEMI-STRUCTURED INTERVIEW QUESTIONS

1. What did you enjoy the most from the PLC? The least?
2. What other experiences have you had as part of an organized group of educators? What benefits did you gain from that?
3. How has participating in the PLC been different from other groups of educators you have met with regularly?
4. What kind of things have you changed in your instruction because of this experience?
5. What motivated you to make changes in your instruction?
6. What would you identify as having the most impact throughout the PLC process?

APPENDIX D

MAIT RESULTS

Pre-Survey MAIT

Question	Instructor									
	A	**B**	**C**	**D**	**E**	**H**	**I**	**J**	**K**	**L**
1	4	3	4	3	4	5	4	5	4	4
2	5	5	4	5	4	5	2	4	4	5
3	4	4	3	4	4	5	4	4	3	4
4	4	3	4	4	5	4	2	5	4	4
5	3	2	3	3	3	4	2	4	5	4
6	4	2	3	2	3	4	4	5	5	4
7	3	3	3	3	4	4	3	3	4	4
8	4	3	4	4	3	4	4	4	4	4
9	5	4	4	4	5	4	4	5	5	4
10	3	2	4	3	4	3	3	4	5	4
11	3	3	4	3	4	4	4	4	3	4
12	4	2	3	4	4	5	4	5	4	3
13	5	3	3	4	5	3	3	5	5	4
14	4	2	3	4	3	4	4	4	4	3
15	4	3	4	4	4	4	5	5	5	4
16	4	2	4	2	4	4	4	4	4	3
17	3	2	4	3	4	4	5	4	4	5
18	4	3	4	3	3	4	5	4	4	4
19	5	5	4	5	5	5	4	5	5	5
20	4	5	4	4	4	5	4	4	4	4
21	2	4	4	1	4	4	2	4	4	3
22	3	4	4	2	5	4	4	4	4	3
23	3	4	4	4	4	4	4	4	4	4
24	2	1	3	1	3	4	4	4	3	3

Post-Survey MAIT

Question	Instructor									
	A	**B**	**C**	**D**	**E**	**H**	**I**	**J**	**K**	**L**
1	5	4	4	3	5	5	4	4	5	4
2	5	5	4	4	5	5	4	5	5	5
3	5	5	4	4	5	5	4	4	4	5
4	4	2	4	4	5	5	3	4	5	5
5	4	2	4	2	4	5	4	4	5	5
6	4	3	4	2	4	5	4	4	5	4
7	4	4	3	3	4	4	3	5	4	4
8	4	4	4	3	4	4	4	5	5	4
9	5	4	5	5	5	5	3	4	5	5
10	5	2	4	1	4	4	3	4	5	4
11	3	4	4	2	5	4	3	4	4	5
12	5	3	4	4	4	4	4	4	5	4
13	5	3	4	5	5	4	4	4	5	4
14	5	3	4	4	3	4	4	4	5	4
15	5	4	4	4	5	4	4	4	5	4
16	4	2	4	3	4	4	2	4	5	4
17	4	3	4	3	4	4	4	4	4	4
18	4	3	4	2	4	4	4	3	5	4
19	5	5	5	4	5	5	4	5	5	5
20	5	4	4	4	4	4	3	4	4	4
21	4	2	4	1	3	4	2	3	4	4
22	4	3	4	3	5	3	3	4	4	4
23	4	4	4	4	5	4	4	4	5	5
24	4	2	4	1	2	4	2	3	4	4

APPENDIX E

PRE-QUESTIONNAIRE RESULTS

Question 1: What do you understand to be the definition of a Professional Learning Community (PLC)?

Instructor A: A group of similar professionals who share their teaching information, techniques, etc. with others in their profession.

Instructor B: A PLC is a place for colleagues to gather and discuss ideas, problems, and solutions that they are currently dealing with.

Instructor C: Instructors sharing teaching methods and experiences.

Instructor D: A group of professionals sharing their experiences and resources to improve their performance.

Instructor E: A group of colleagues working together towards a goal.

Instructor H: A community where different teaching styles are shared.

Instructor I: PLC, if done correctly, will benefit the growth of the teachers to reach mastery and provide an impact for the students.

Instructor J: That all parties will discuss and help each other to improve what they do as a professional. In our case to be a better instructor.

Instructor K: A PLC is a group of instructors working together to use results driven decisions to maximize student learning in a cooperative fashion.

Instructor L: Group of professionals who are committed to improving their practice by

collaborating together and investigating current trends

Question 2: What perceptions do you currently have about PLCs?

Instructor A: That, if done correctly, could be very beneficial for the group as a whole.

Instructor B: I don't know enough about PLCs to have an actual perception, but I hope that it is not solely going to be a place for us to complain (which is often what ends up happening).

Instructor C: I do not have any perceptions.

Instructor D: I have limited knowledge of them

Instructor E: They have potential but are often lose direction and focus. To be effective there needs to be one or two distinct goals. They are commonly used to 'check the box' to show that something is being done. Often they become complaint sessions, focus on the exceptions, and are a waste of time.

Instructor H: I think it will help exchange ideas to better tach students

Instructor I: This is my first PLC. I have heard from other teachers in high school to have them rallied together so everyone is on the same page.

Instructor J: They should be very helpful.

Instructor K: PLC's can be very effective when teachers are given the resources they need to make the changes the determine to be in the best interest of the individual students and in the best interest of the school as a whole.

Instructor L: I think they are as effective as the commitment the members have to it. They can be very helpful if everyone in the group is motivated towards the same goal

Question 3: What do you anticipate learning by participating in the PLC?

Instructor A: New or different teaching techniques that would directly benefit my students.

Instructor B: I want to learn to delegate responsibilities, how to work smarter not harder, active learning techniques, and how to increase student engagement while online.

Instructor C: New ways to teach.

Instructor D: Currently - how to utilize different tools for hybrid and online classes. How best to communicate with students.

Instructor E: I hope to learn something that applies in the classroom that is student focused and not just how to follow rules.

Instructor H: I anticipate learning new teaching methods of especially complicated topics.

Instructor I: I hope to learn new ways to teach effectively and help the students grow at [the Technical College].

Instructor J: How to improve what I do as an instructor.

Instructor K: Practical ways to improve both the efficiency with which my students learn and the mastery level they ultimately reach

Instructor L: I hope to learn more about effective teaching practices, specifically how to gauge student confidence with the material

Question 4: Have you ever participated in a PLC before? If so, what was your experience like?

Instructor A: I think that our Life Science Bookclub was like a PLC and it was very helpful.

Instructor B: Not formally; just impromptu hall meetings. :)

Instructor C: No.

Instructor D: No

Instructor E: Yes. As stated above they become complaint sessions and lack focus.

Instructor H: No

Instructor I: No.

Instructor J: Not sure!!! I think the book club we had could be considered a PLC.

Instructor K: No.

Instructor L: No

Question 5: Do you anticipate that the PLC will change you in any way? How or why?

Instructor A: Yes, it will provide for me more innovative techniques and methods of teaching that will directly benefit my students.

Instructor B: I hope to let go of some of my perfectionist complex. I am worried that participating in the PLC could lead to me comparing myself to others even more.

Instructor C: It may be able to give me new ideas.

Instructor D: I do expect to learn from it, but no I do not think it will change 'me' - as in the core of who I am or my identity.

Instructor E: I hope so but there are a lot of new issues this semester and everyone is focused on rule following more than education of students.

Instructor H: I'm not sure. I hope that it helps with more collaboration and communication between instructors. I also hope that it helps us develop new curriculum.

Instructor I: PLC should provide opportunities for respectful discussions to benefit our goals as a teacher.

Instructor J: certainly hope it does :) By helping me understand what I can do different to be better

Instructor K: I anticipate that I will improve my ability to create effective lessons and to develop a more coherent course

Instructor L: I hope it makes me a better teacher!

Question 6: How do you anticipate your instructional strategies will change as you take part in the PLC?

Instructor A: I would hope, with time, that the new or different instructional strategies would directly equate to a deeper knowledge of the material and thereby relate to better grades.

Instructor B: I hope to do better with student engagement in particular. I absolutely think students login and leave their computers. I only have the same four students answering questions the entire class.

Instructor C: Incorporate new ways that I think will work for my classes.

Instructor D: Again, I am hoping to improve the technological and communicative aspects of my teaching.

Instructor E: (no answer)

Instructor H: (no answer)

Instructor I: This will provide other instructional strategies which may not have been realized prior to the meeting.

Instructor J: I hope it will improve :)

Instructor K: I anticipate that my overall instruction strategies will become more focused on student engagement as I learn to develop a more cooperative way of working with my peers, I should also become better at begin working cooperatively with my students.

Instructor L: I hope they will expand and I will learn new techniques

Question 7: How much time do you spend planning lessons before class? How is this time divided between designing the lesson and collaborating with colleagues about that lesson?

Instructor A: Not, as much time as I would like to especially with the current state of teaching. With numerous emails, online teaching, hybrid teaching, etc, etc. there does not seem it be enough time to plan lessons.

Instructor B: I probably spend about 15 minutes to half an hour planning individual lessons. Most of my time is spent on curriculum development (for the past year or so), so I haven't been able to focus on teaching strategies. I usually don't collaborate with others unless I need a fresh idea.

Instructor C: It depends on the course...I can spend 30 mins to 5 hours. I design the lesson first, then if I have questions, I would collaborate with colleagues. It's designing the lesson that takes up most of the time.

Instructor D: The first time I teach a class, I spend about 3 hours for every 1 hour of teaching. I do not spend much time collaborating. I may ask a few questions to other instructors, but I've never had the opportunity to develop a lesson or course with another instructor.

Instructor E: About 1-2 hours for lecture 3 hours for lab. No collaboration due to the current online environment.

Instructor H: I spend maybe and hour or so preparing for my class before i teach it.

Instructor I: I spend a great deal of time planning a lesson after collaborating with my mentor who has taught others effective teaching strategies. I would like to have less time planning a lesson and more time honing on the benefits of the lessons and pick up in areas which may be lacking.

Instructor J: It depends on the lesson. I would say about an hour or so and perhaps few emails with others to get their input.

Instructor K: I spend about 3 -4 hours per lesson. I have very little collaboration with colleagues.

Instructor L: On average I spend somewhere between equal and double the time planning a lesson as I do teaching. I mostly work on my own but occasionally I will ask colleagues for advice

Question 8: How much time do you spend reflecting on lessons after class? How is this time divided between revising the lesson and collaborating with colleagues about that lesson?

Instructor A: Similar to question #7. [Not, as much time as I would like to especially with the current state of teaching. With numerous emails, online teaching, hybrid teaching, etc, etc. there does not seem it be enough time to plan lessons.]

Instructor B: I do talk with colleagues when something goes really well or really poorly to try and figure out a game plan for next time. However, I rarely self reflect. At the end of a class, I often feel drained and do not have the energy to put into reflection.

Instructor C: Sporadically, maybe an one hours. I would consult with colleagues if it was a bad lesson, reflect, and then revise. It's the revision that will take up most of the time.

Instructor D: I typically revise the next semester when I teach the course. If the class went particularly poorly, I may discuss it with a colleague after class, but it is never a formal collaboration. My revisions to material I have taught before may be more of a 30 minutes of prep to every 1 hour of teaching.

Instructor E: 10-15minutes.

Instructor H: I always reflect on each lesson after I teach it. I am constantly thinking of new ways to improve teaching the same topic the next time.

Instructor I: If I a classes on the same day or the next day, I will see what could provide to my later class which may have not been smooth in first class. I have not had much time reflecting on the lesson with other colleagues.

Instructor J: Maybe about half an hour. I do ask others how they presented the material and try to compare and decide if that's something I want to try.

Instructor K: I usually spend about 1 - 2 hours reflecting on a lesson and trying to make changes that would be more effective for the next time I teach that lesson.

Instructor L: About half the time that I was in class. Again generally I do this on my own with occasional collaboration if the opportunity presents itself

Post-Questionnaire Results

Question 1: What do you understand to be the definition of a Professional Learning Community (PLC)?

Instructor A: Learning and sharing various forms and techniques for teaching more effective in the classroom. Learning new techniques as well as refining old standard techniques.

Instructor B: A PLC is an opportunity for colleagues to come together and brainstorm/vent/share ideas regarding current tasks and issues in the department.

Instructor C: Everyone sharing techniques about teaching.

Instructor D: An on-going meeting used from professionals to learn from who another's experience and grow in their own practice. The community gathers data as a group, evaluates the results, and makes changes accordingly.

Instructor E: A PLC is a collaborative network of colleagues in a specific field who share common professional goals.

Instructor H: Its a community of instructors that discuss how to better facilitate student learning

Instructor I: PLC's are an ongoing process impacting the structure and culture of the school and the practices of the professionals within the school.

Instructor J: A community that instructors can discuss ways to teach the material better and come up with ideas to improve their teaching

Instructor K: A PLC is a group of educators who meet regularly to collaborate on ways to improve student learning.

Instructor L: A group of professionals who want to continue to improve their practice and help each other do so

Question 2: What perceptions do you currently have about PLCs?

Instructor A: It was very helpful!

Instructor B: Having a PLC can be very helpful. However, when there are too many people, it can lead to too many opinions. There were several times we met to discuss a certain topic but never actually came to a consensus. Maybe they require more structure?

Instructor C: It is sometimes useful.

Instructor D: Useful tool especially in a time when we needed a platform to stay connected. It needs structure and drive from the members in order for it to stay most effective.

Instructor E: They sound great in theory but rarely contribute to conceptual change.

Instructor H: I find it useful to discuss ideas amongst my peers

Instructor I: As a new teacher, I have heard mixed reviews from veteran instructors as well as new instructors. I believe PLCs are helpful for all instructors to have clarity in as a division to share practices to help the division grow as a whole.

Instructor J: A community of colleagues that can help you with your teaching as well as other duties.

Instructor K: PLC's can be quite beneficial when the group is allowed to determine a plan for improvement and is then given the time and resources necessary to implement that plan. The success of a PLC hinges on the group being able to trust that all members will bring an honest effort to improve learning and not some hidden agenda.

Instructor L: They are a helpful way to continue to sharpen your skills, while also building professional relationships and expand your network

Question 3: What did you learn by taking part in the PLC?

Instructor A: Commiserating with colleagues on the challenges of teaching, teaching techniques, and of course funny stories.

Instructor B: As one of only a small amount of instructors teaching a specific subject, I felt that I couldn't ask for help or insight since other instructors were not familiar with my topics. Through the PLC, it has opened my eyes that we are all going through similar problems, even if my colleagues might not be able to help come up with an idea for a specific topic in my lesson.

Instructor C: Other techniques to teach in online labs.

Instructor D: Student who use a varied number of study techniques do better! While that may seem small, I think it was a big crack in the code.

Instructor E: It seems our group has more immediate issues to discuss rather than professional goals.

Instructor H: I learned of a lot of different techniques from other instructors, ones I may use for myself.

Instructor I: The PLC helped clarify many standards, beliefs, and teaching practices of the instructors within the Life Science Division.

Instructor J: How to improve my teaching and how to deal with difficult situations.

Instructor K: Many of the issues that I face as an instructor are shared by instructors in different curriculum areas but the way we need to address those issues can vary widely. Working with a collegial group provided me with a wide variety of possible ways to approach each issue and gave me a broader understanding of student engagement. A good PLC consists of a group of educators who are not "tied" to a particular role but can operate as a group of peers who are all interested in the same goal.

Instructor L: I'm not sure that I necessarily learned anything new, in terms of new teaching techniques or things like that, but I felt like I learned more about my colleagues and that it strengthened our department. I think it helped everyone feel connected which is important when we have been virtual for so long. In a department like ours where everything from the curriculum to the exams is standardized across all classes it is important for the instructors to check in with each other to make sure we are still working as a team and no one is completely doing their own thing.

Question 4: Now that you have participated in a PLC, how would you summarize your experience?

Instructor A: Well worth my time and would like to do it again.

Instructor B: Overall, I think being part of a PLC has been beneficial in terms of hearing input from your colleagues, making your voice heard, and brainstorming new ideas and policies. Personally, it has made me slightly incompetent due to feeling like I did not have much to contribute.

Instructor C: It's useful.

Instructor D: At first it was a venting session. In time we learn how to make use of our 30 min sessions, and evaluate data that has been collected in our department. I would like to continue.

Instructor E: I love to talk and discuss with my colleagues but it is hard when we went off topic so much and rarely discussed useful professional learning techniques.

Instructor H: Overall, I feel it was a positive experience. I was able to express many ideas and receive feedback about them.

Instructor I: Listening to the challenges and success of other instructors has been very helpful in helping the students grow.

Instructor J: 1. Ways to teach better 2. Be more sensitive to students and their situations 3. How collaborating with others can help me to improve not just being a better instructor but a better person!!!

Instructor K: This was a very positive experience for the most part. We had some spirited discussions where differences in opinion were voiced and accepted by all. It is nice to be a part of a group that can discuss differences openly.

Instructor L: Talking to my colleagues in this type of setting helps my imposter syndrome. I feel validated and reassured that I am doing things correctly and it gives me confidence to follow my instincts when I am trying out new techniques.

Question 5: Has the PLC changed you in any way? How or why?

Instructor A: Yes, to introduce different ways of teaching even if they are only small changes.

Instructor B: Being part of a PLC has helped me realize that asking for help is okay. However, it has also caused me to feel incapable by seeing how innovative other instructors are. It makes me want to do better for my students.

Instructor C: I can be more interactive in lab.

Instructor D: I now know what a PLC is and I would like to continue participating at GTC. It felt more practical to gather and evaluate data than to hear anecdotes and opinions.

Instructor E: No, but the questions in the questionnaire did make me think about when I assess if my teaching technique is working and if I should look into 'if I have considered using all possible techniques after teaching a point.' I do not think this is possible in real life but I think I could consider new techniques.

Instructor H: It will take some time for me to reflect on what I have learned and perhaps incorporate techniques into my teaching.

Instructor I: The PLC helped promote growth as an instructor and learn how to tackle situations that have occurred during the semester and provide insight into challenges yet to come.

Instructor J: Yes. To be a more compassionate instructor!!!

Instructor K: The PLC has given me a broader sense of how to utilize my talents and a wider variety of "tools" to use to engage my students, particularly in an online setting. I have been modifying some of the assignments that I plan for next semester and I have been thinking of ways to modify my synchronous learning sessions to be more productive and efficient.

Instructor L: Same as #4. Talking to my colleagues in this type of setting helps my imposter syndrome. I feel validated and reassured that I am doing things correctly and it gives me confidence to follow my instincts when I am trying out new techniques. Not necessarily, but I have more confidence in my online teaching skills

Question 6: How have your instructional strategies changed as a result of taking part in the PLC?

Instructor A: I am working on that. The currently teaching conditions with COVID have made that a little more challenging.

Instructor B: This semester, my instructional strategies have not changed because I have been redoing the curriculum. I plan on using some of the online techniques in the next semester.

Instructor C: I will try more lab online techniques.

Instructor D: We didn't spend that much time talking about instruction. My online teaching did evolve, but I believe that was more to do with learning the platform.

Instructor E: (blank)

Instructor H: It will take some time for me to reflect on what I have learned and perhaps incorporate techniques into my teaching.

Instructor I: I learned how to effectively prepare and teach using different strategies.

Instructor J: I think I have learn more on how to deal with different situations more than how to change my teaching!!!

Instructor K: I will be including many more instructional support activities for students to build their mastery without worrying about the effect it might have on their grade.

These practice activities should lead to a better understanding on the content information and the skills needed to complete actual assignments.

Instructor L: For a class that I have taught before, I spend about half the time that I will be in class prepping for it. Example - for 2 hours and 40 minutes of lecture a week I will probably spend 1 - 1.5 hours at the beginning of the week reviewing my slides, rearranging things to flow better, and thinking up new activities to do during class. I don't usually consult with colleagues unless I have specific questions about the material.

Question 7: How much time do you spend planning lessons before class? How is this time divided between designing the lesson and collaborating with colleagues about that lesson?

Instructor A: 45 minutes to 1 hour of review, prep time, thinking of different ways to teach a particular topic prior to class.

Instructor B: I unfortunately have not had much time to plan lessons for the past several semesters. I will usually think about the lesson the day of. If I am fresh out of ideas, I will collaborate or ask others for help.

Instructor C: Two to ten hours depending on the class.

Instructor D: The first time I teach a lecture it often takes me about 3 hrs to prepare for 1 hour of class. I rarely discuss it with others - but I do observe others before teaching and ask questions via email. Probably 70% is spent on my own compared to working with others.

Instructor E: Depends on the class. At least one hour for each lecture and each lab, sometimes more. If it is a new class I am teaching it is a lot more, 2-3 hours per lecture or lab. Only about 0- 10% of the time is collaborating with colleagues about the lesson.

Instructor H: It depends on the class and subject I am teaching. If its something I have not taught in a while I will spend an hour or more. I do so after every lecture.

Instructor I: I spend at least 1-2 hours preparing a lesson before providing a template for the students to view. My collaboration with other instructors still needs more improvement.

Instructor J: In the past few months I have spend 4-5 hours a day planning for my lessons. I collaborate with colleagues at least 2-3 hours a week.

Instructor K: I usually spend one to two hours preparing a lesson. Unfortunately, that rarely includes collaboration time.

Instructor L: For classes that I have not taught before I spend about twice the amount of class time preparing on my own (2 hours of prep for 1 hour of instruction). I would also spend time observing veteran instructors/asking questions so that would probably come out to 3-4x more time preparing than teaching.

Question 8: How much time do you spend reflecting on lessons after class? How is this time divided between revising the lesson and collaborating with colleagues about that lesson?

Instructor A: 15 to 20 minutes, if I am not interrupted.

Instructor B: I usually spend about 10 minutes after class thinking about how things went. If I feel that a certain lesson was a "failure," then I will spend extra time thinking of how to improve upon it for next semester, or try to come up with a new way to explain it for the next class. I often do not collaborate with colleagues after a lesson.

Instructor C: 2 hours

Instructor D: I do my revisions the next time I teach it! I have talked to other colleagues about lessons that have gone poorly, but most is spent on my own.

Instructor E: As long as it takes me to walk to lab or my office.

Instructor H: I do so after every lecture.

Instructor I: I spend at least 1 hour trying to think of different teaching techniques. My collaboration with other instructors still needs more improvement.

Instructor J: I spend a lot of time reflecting on my teaching and how I can improve it. Sometimes few hours a day. In the last few months I have spent at least 1-2 hours a day collaborating with colleagues.

Instructor K: I usually spend one to two hours reflecting on lessons after class. That rarely includes collaboration time.

Instructor L: I don't usually mechanically revise the lessons (in terms of reworking the powerpoints/materials) until I am getting ready to teach again. Unless a lesson went very poorly, in which case I might revise it right after doing it while it is fresh in my brain. So generally 0-30 minutes?

APPENDIX F

SEMI-STRUCTURED INTERVIEW RESULTS

Interview Transcript: Instructor A

Participant-Researcher (PR): Cool, all right, well, the first question is, well, I guess what did you enjoy the most from the PLC that we did last semester?

Instructor A (A): When you go "the PLC," that's that meeting that we had at like four o'clock.

PR: Yep.

A: The hallway meeting, as you referred them to.

PR: Yeah.

A: Well, gosh. Several things, uh. Part of it was just being with colleagues, and I think sharing a lot of the same issues that we all have, and I think venting, venting was very helpful, especially when times within the semester were frustrating. You could kind of vent, and I think that's beneficial because it makes you feel like you're not alone. You know that you're not the only one dealing with those issues. The other part was, is sharing information. Sharing concepts and ideas like certain people seem to be more techie. They understand that techie stuff you know and so can share that with people who are not as techie and just those that are more seasoned instructors sharing with, you know, others. And then, of course, those that are kind of new to it that come in with the fresh ideas or fresh concepts that you know, maybe people who have been in it for a while aren't aware of, you know, so that was the main thing that I found it. It's the camaraderie, the sharing, the venting, and then the sharing of the different ideas on, on teaching and how to be better at it. Things like that.

PR: Uh, what did you enjoy the least? Or was something you, you didn't like about the PLC or the Hall meeting?

A: What didn't I like about it? I think this was very minimal, probably just getting like way off-topic into other things that didn't pertain to it because I think that's the big thing is that I think people can get meeting…meeting-d out. You understand that term?

PR: Yeah.A: You know, by making meetings that go on too long and just, it becomes just this, you know, moan and groan session that just keeps going and going instead of coming to, not that that's not a good thing, but then kind of coming to conclusion and moving on. Not keeping that. So if anything, maybe that part of it or the meeting like OK, this should end it about 20 minutes ago, and we're still going on this kind of thing.

PR: Like about the same topic. Yeah, we tend to do that.

A: Yeah, then not coming to a resolution or conclusion, or you know, answering it to some degree or saying, OK, let's table this or what, you know, let's make a decision, and we'll put a sunset clause on it. Let's give it a semester or two to try it. You know, whatever the decision happens to be, instead of it just kind of rolling, and rolling, and rolling with no conclusion.

PR: So…what other experiences have you had as part of, like an organized group of educators that meet? Besides these hall meetings.

A: The book club. I think when we had the book club when that within it's kind of it's hey-day, I always really enjoyed that, and that's why I used to drive over there even though they offered it virtual there for a while. I would always make the attempt to drive over and be with everyone because I think there's a something good about just seeing everyone. You know, I'm just trying to be part of the team and things like that and not being virtual. Um, it was, you know, kind of beneficial to, um, you know, to go over there, but I, I thought that the book club was one of those things.

PR: What other benefits did you get from the book club?

A: Well. It kind of forced me to keep on top of, like the readings and doing things like when you get caught in the semester and all the things that are going on. You know, trying to do and learn new things, even if it's just a little bit of something to help you become a better instructor. I think the book club forced me like, oh it's next week I better read my chapters, you know, and do that until I was sitting there you know, eating lunch, I would read, you know, part of the chapter so it kind of kept me in that, "Look, like oh shoot, I better I better read up on it. So at times, you didn't want to 'cause you had other things going on that kind of kept you in that mode of keeping up on the material so that you were prepared when the meeting happened.

PR: Uh-huh, so kind of like forced you to stay current in some ways?

A: Yeah, yeah, yeah.

PR: And then I guess with the PLC, with the hall meetings, how was participating in that different from the book club meetings when we, you know, we were meeting regularly?

A: Um? Less formal preparation for it, I mean, we had, you know, kind of topics and things there. So there's, there's less preparation or and I guess when we have the meetings at, that means, at the hallway meetings we were dealing with like the current topic like the current issue that was going on with students where when you have the book club it was like whatever the book was talking about, you know and, and, you know, how to use that in in class. You know that's what we were using, but when we got to the hallway meeting, it was like what's currently going on, like the issues with Respondus and students cheating. Like, what did you see? What did you see? What did you see? You know? So that's what was kinda cool. It was like what was going on at the moment. How do we deal with it, and how do we work with it?

PR: And I guess, what…What benefits did you see from that? Compared to kind of, I guess like a curriculum from the book club.

A: I, I guess we were really able to, because that, at the moment, really helped me with what was going on, like those issues that were going on like with Respondus. I immediately got feedback from other instructors about what they were doing, what they were seeing, and it either verified what I saw, but it also gave me other things to look at, so it kind of gave me immediate information. Immediate data that I could use, like as soon as we hung up, you know, and, and utilize that for the for the, for what was going on. In the past, the book club where I may have to do a little preparation, I may have to, you know, if you think a little bit more there, be a little more involved with the hallway meeting it was more immediate, you know those things that I learned. I could look implement, look for, do, you know, at that point.

PR: Like, based on those things, did you make any improvements to your teaching or any changes in your teaching as a result of that? Um, I guess like any changes or improvements based off of the PLC.

A: A lot of it too, I think was, especially with the online teaching, which is so foreign to me. You know, because I personally prefer face to face, that's kind of where I feel like I shine the most. But at least hearing, when I try to do things for online to try to make it energetic. You try, you know, as much as you can do over the internet. I guess hearing and validating what I was doing. Like, people say, oh, wow, that's cool. I want to use that or hearing other people do that and go OK when I'm doing this right. So I think that's what was, what was good about that as well is just getting that, you know the areas that I wasn't comfortable in, and yet I've done things where I think, OK, I think this is gonna work. So again, get that validation that, oh wow, that is working, or that's a good idea. Or then hearing something from someone else saying, try this, do this, do that. So, because you're online, you could have, we could literally do it, you know, your next class, you know you could implement that little thing. It doesn't take a whole lot of preparation to, you know, try to do a little more engaging with students, and you know little tricks like polling and things like that. That should take me two seconds to do a little polling thing to try to get students more engaged.

PR: And I guess can you give an example, like or, you know, go a little bit more in detail about the polling thing of, like, something you, you changed because of that experience?

A: Um? I think my biggest thing with the the online thing is trying to get when you first when you have a large class of getting them to engage. Uh, especially the what I call the fringe students who don't ever seem to engage. And I like to kinda, you know, josh and, you know, get them to, to respond, and so you know the polling got me to at least look to see, you know, who was popping up, and I'm like, OK, there's 42 of you out there, and I'm seeing 24. Come on, keep going, guys. Come on, answer, answer, you know they're all the sudden [bloop bloop – chat notification noises]. You know, they, so, granted, there's always going to be like a few who don't respond or they're in another room having a cup of coffee and, uh, not even in the class, you know. Which could be happening, but again, the polling just gave me another tool to get students who, again are on the edge, to engage a little bit, throw out answers, you know, do little things like that, and then as you're going along, to again, to try to pull them in and be involved in the class when you're in this virtual world.

PR: And I guess, you know, based, thinking about like, the PLC and what we talked about and then the change that you made in your class. Like with the polling, I guess, what motivated you to make the changes in your instruction?

A: I, I would say it is to get to the students, to help the students. To get more students to learn, to study, to, you know, I guess it's all about the student. You know, that's, that's always my thing. I mean, I know we have that withdraw-failure rate that is hard. Saying that you know, 50%, you know withdraw-failure. My goal is always to just one more, one more. Is it one more student that this is gonna help them get over to the point that they're gonna study a little harder and focus a little more and better and get to their program. And you know that kind of, you know, saying it's just, just one more. You know, and then I guess that's where my mind goes is, you know, is this gonna help just one more student? You know, to maybe engage them, especially that's the big feedback I get. They don't like the online. They want to be face to face. They want to be interested. That's the big complaint for most of the students. When I looked at my surveys is that they, were they, they didn't like the virtual. They don't do good in the virtual, you know I get it, I don't. I don't like it either. But while we're doing it, how can I do better, do it to maybe just pull one more through, you know.

PR: Um, so do you feel like the PLC helped you? I mean, obviously, you know you said that it helped you with, you know, coming up with ideas like polling during the semester, but do you feel like it helps with planning for next semester?

A: Yes, yeah, because a lot of those things you kind of learn through the semester were now, I'm going to be able to use those things from day one. I'm gonna use different things that I picked up, you know, during the various points of those meetings, and now I have those things that I can then use, you know, carrying forward from day one in the next semester.

PR: And you know, do you…like looking back? Do you feel like, or I guess how do you feel like it helps you evaluate your teaching? Or do you feel like it helped change the way you think about teaching?

A: Yeah. You know, I'm not a big fan of virtual. I'm not a big fan of it for A&P, uh, you know, there'll always be probably some piece of virtual whether it's a lecture or something that's out there that we, we may still have to do when all of this is over. So I think you know, I think yes, it, it helps me to focus on an area that I never had to deal with before, you know. And it was one of those things. Like, alright, you're gonna either sink or swim, and I chose to swim. And so I said, OK, let's just learn this stuff. Let's pick up on this stuff so that, you know, we can do better this coming semester. And if, for whatever reason, once all this COVID is over and we still have some level of online teaching, I can continue to use that and continue to try to help students.

PR: And we're in the homestretch here. Last couple questions. What would you identify as having the most impact throughout the process of these meetings?

A: Having most impact. Um. Validation. And what I mean by that is, because we're all isolated for the most part, when you have your frustrations of being at home and being on your computer and doing this kind of stuff, and everything is emails and virtual. I found it important that when we are, we got together even though it was virtual, to validate your feelings, your frustrations, those things that were going on that we all were thrown into by no one's choice. That like, OK, I'm not the only one dealing with this. You know everyone else feels the same way. This is how they're handling it, which you know with their, or what I shared, help them. You know that kind of thing, so I think in the current situation, that's probably the biggest thing is just validating your your feelings, your emotions, your frustrations and that you weren't alone in tha0,t kind of that community thing that, you know. And of course, we all joke and laugh and do things like that. And I think that's benefit to it as well. That we can just then, OK, let's push on, you know we can do this. You know I'm not the only one in the midst of this, so I think that's probably the one big take away, I would say.

PR: Yeah, so would you want to do it again? That's the big question.

A: Yes, yes, I would. Very much so. Like if we could keep it how it was towards the end, you know where it was just kind of short, to the point, making major topics, you know, to the point that they don't, you know, just drag on, drag on, drag on where people are going to go, "oh another meeting." But I think we can keep them the way they work. You know, with kind of a timekeeper, the same. I think they would be beneficial.

PR: Yeah, so looking at your, I guess individual answers, something that you scored really high on at the end of the semester compared to the beginning of this semester, it was actually your evaluation or self-evaluation. Um, so on the survey, things like, "I know when each teaching technique I use will be most effective," "I organize my time to best accomplish my teaching goals," "I ask myself questions about how well I'm doing what I'm teaching," and, "I ask myself if I have considered all possible

techniques after teaching a point." Um, do you…What kind of things from the PLC do you feel like contributed to that, I guess, change in mindset?

A: Yeah. Yeah. I guess the mindset that was there is just, by sharing all those concepts, I guess just gave me more motivation to use those things and use them immediately and getting a feedback from the students, which motivates you more. You know when you get those comments, you know, and I just, you know I ask, "hey guys is this working," and they're like, oh my, this is great, this is great and getting that immediate feedback from students that sometimes maybe face to face they don't always say because they're in a group and like, I'm not gonna say anything. I don't, you know, I don't want this guy next to me to look at me, or I guess because there are virtual, they can like type in like, "oh, this is great keep going." You know they'll show things in because they don't have any peer pressure not to respond. You know that they're free to respond. They feel comfortable responding, so getting that immediate feedback from students for things that I try, or things that I did, or things that I would try and like, OK, is this gonna work? Do you guys like this, and they're like, "oh well, that was awesome," you know? So you get that, so I think that was almost a self-motivation that, I go, "cool, I'll do that again," you know, and I think that's what kind of perpetuated that process from the beginning to the end is that anything you tried getting that feedback from the students and I think again, different that there may be more feedback in the virtual world and my only thinking is it's because they don't have peer pressure when they're in the classroom like, "I know I'm gonna sound like an idiot, so I'm just gonna sit here quietly." You know where in the virtual world they're like, "Hey, that was awesome," or "no, that sucked." Whatever it happens to be there, they're much more forward with that, and I think that's a positive thing for instructors to get that immediate feedback.

PR: Yeah, so kind of like you got an idea. You tried it out. The students gave feedback, and then that made you more, I guess, confident to be able to try more things?

A: Mmhmm. And to go from there. Yeah, and again, my point is that I think in a face-to-face class, I don't think you would get as much of that kind of feedback because I think they make you sure you always get that one student, right? Yeah, you know they talk in there, but I think the bulk of students are less likely to respond in a face to face where online; I think they feel probably a little more open to throw it out there 'cause, "no one knows me…you don't know me. I don't know you. I see a little picture of you with, you know, a little funny hat on your head, and I don't know you from Adam." Yeah, you know, so they're more apt to share where in a classroom, maybe they're not as much.

PR: OK, and I guess do you think with us, you know, being online versus in person, do you think we were as likely to share, or more likely to share things online versus in person?

A: You mean our meeting time?

PR: Yeah, in our meeting time, or do you do you feel like it would have been the same? Regardless or different or.

A: I, I yeah I, I think our crew, overall, we're all pretty open and fun in that regard, and I think we would. Oh, I think we would all share a regardless, you know, whether we were virtual or face to face, you know. I think that's just the nature of our group.

PR: Yeah, we, we do have like a good camaraderie with each other, too.

A: That's why I think we could joke. We could tease each other. We could get angry with each other and still be good. You know, I, I think, would go either way. I think it could go either way.

Interview Transcript: Instructor I

Participant-Researcher (PR): First off, like what was something that you enjoyed the most from the PLC?

Instructor I (I): Um, obviously hearing from other teachers and how they, other perspectives, like teaching strategies. Especially coming as a new teacher into the field…I don't have that much experience, so I'm pulling what I can; using, you know, previous teachers' strategy, so I like, in the first semester, I downloaded all of…[Instructor B's] PowerPoints, [adjunct instructor's] PowerPoints, you know, any instructor I could, you know, find. I was looking at their data along with researching the textbook, so we can, get, develop some strategies for how to teach some things and then, as time went on, um, you know, started talking more and then realize, hey there was so many other avenues you could look at. And I don't want to stop learning, so I'm constantly learning, constantly adapting at this point, and I, I in the foreseeable future, I feel like I still am going to be adapting. Shouldn't be a still teacher. Um. So that was the biggest thing this is learning from, at least from the limited time because I had, um, I had organic lab that kind of, you know, sort of pushed me out of a lot of the meetings. So that was during my organic lab time. And based on that, I think I went to like three or four of the meetings. Yeah, I think end of term. Um. That helped me immensely because they kind of got us on the same page. I felt like chemistry was disconnected from biology along with A&P and honestly even physics, at least from my standpoint because I didn't know about all this. And that sort of the PLC is sort of bringing us together. And I, I like that aspect is that we're, we're bringing departments to work together to strengthen the entire department as a whole.

PR: So I guess what, what was something that you liked the least from the PLC?

I: Um. Honestly, it was, yeah, it started turning into a, a complaining ground. And PLCs are supposed to be growth based on upon what [my wife] told me. It's supposed to have everyone grow together rather than, you know, trying to be bogged down, and so I think that was the least thing I honestly enjoyed was that complaint factor, but it was necessary to know where the problems are so we can work together.

PR: Do you feel like that progressed during the semester, or do you think it kind of stayed the same in terms of that growth?

I: As far as the growth together.

PR: Or yeah, that in the complaining.

I: Oh, the complaining grew. Uh, progressively more, but uh, I feel like the growth was actually slow. It was a slow, slow growth from what I can see. Oh. As well coming in brand new at doing this online stuff, so we don't have a lot of data behind ourselves, and we're trying to do the best we can on learning that. You know everything coming at us. We're still constantly learning how to do this effectively online. Um, you know, as as you

know, we're trying to compare it with how we did in person. So. Yeah. That was. That's something, at least I notice, and I I felt like I was a little bit better, but then that starting and then I realized I haven't been doing as much as I thought by listening to the everyone else when I was in the PLC. Listen to their strategies. Listen to their communication, and I realized how much I'm still lacking.

PR: Can you give an example of that?

I: Um, communication is the prime example, and that's something that I'm having, I'm gonna be picking up, um, next semester is communicating with everyone, but that's, I communicate with students. I don't know how effective I am at communicating with other instructors. That's a prime example, and that's something I'm wanting to create a checklist for so I know what am I covering, trying to get us on the same page. We were kinda like all over the place a little bit as far as like, starting the semester we don't have communication, so. And looking at it from the syllabus, I had my syllabus made and ready, and that was used as a template. But it got changed, um, and I didn't read the updated one. That took out one specific piece of information. And that was something like dropping the lowest assignment grade. So we didn't. We were not on the same page. For that, uh, and even on adjunct instructors, we're not even on the same page. So they're like, are we dropping anything, or what are we doing here? And then that's when we found out, oh, we're dropping. You know such and such from the grade book. And there's just like, when was that made announced? So anything? New idea? So. It was a; it was sort of like a communication type thing, that's something. Yeah, it's it's gonna be little by little growth. Yeah, I'm gonna try and learn how to at least keep everybody on the same page by having more, at least more transparency is the best word.

PR: Do you see that being different since we were in like an online format compared to? Like if we were in a face to face format?

I: Um? Well, if I'm using the past two semesters as a, um, experience, we're actually more organized and on the same page now, I believe, than we were previously. I, I don't, I don't know as far as like from my experience. We didn't know about the syllabus. We didn't know how things, things were graded or well, at least, at least in the fact of how things were created for the entire, um, chemistry course. That was still kind of, you know, up in the air without solid, at least the foundation. That's transparent foundation that's related. Everyone that was clearly, like an unspoken rule, at least from my standpoint. Yeah, an unspoken rule. Because there was nothing stating, "hey, here's your syllabus. This is what you look for, what you expect. Here's how grades are gonna be, how this is gonna be," until we actually talked with, um, you in biology and you helped out immensely with that syllabus. And giving us a format to go off of.

PR: So I mean, I know you're new to teaching, but have you had any other experiences with, like, an organized group of educators? Besides the PLC.

I: The only, the only one would be honestly back in grad school where I would talk with all the graduate teaching instructors, at least those on the committee. And, and find out

you know, how, how to improve. For at least the next semester. I think that was 2017 was my first with that, and then that's when I started talking with the committee members what not how we can be better. How can we help the other graduate teaching assistants, that sort of thing so I can learn more to ask you, I can help. Other teaching assistants who are just coming in. So that was the only other experience I've had was by talking to that committee at [that university]. Yeah, and, well, obviously [my wife], who has been teaching other teachers at home, too. Yeah, and listening on her conferences. And going to that [learning management system] conference in July. That was the other, other thing was how, how the teachers got together taught and express their strategies.

PR: OK, um so like. With that in mind, like those other interactions that you've had with, with educators, how was the PLC different from that?

I: So instead of it being like a one, almost like a one time experience, yeah, that's pretty much what it was. So like a one or two time, or one to one to two-day experience with a conference like setting or a, just a meeting. This was a continual growth through the several meetings to try and help out. See any potential problems or potential, or see any potential success stories and that's, that, that, that multiple PLC visits actually promoted that, at least on the four I've been to, was more promoting to keep us all informed, on a bi-weekly or monthly basis. Yeah, yeah.

PR: Twice a month, right? Yeah, yeah, I guess so after the PLC, what are some of the things that you've changed in your instruction because of this experience?

I: Um, learning effective teaching strategies, especially from [Instructor D]. That was a really good one 'cause I learned a little bit more, especially from that one PLC, where we had to get together and, and teach and give examples and whatnot. That was the main thing I learned a lot. The second one was how vastly different, um, different course is although they're talking about this, they're all doing their own separate course content, but kind of how different they are in terms of the function. So learning that that gave me an eye-opener there. Um, and so maybe, maybe, that bringing us together…was like, awesome in my opinion 'cause I felt like we, we can now 'cause each each one of us may have a different problem. And we may not have thought of that because each one had, each instructor may have a different way of handling it, and so bringing those affected our teaching strategies. Yes. Like it's hard to visualize without having someone else have someone else doing it and then seeing it from a different perspective. You only see it from your own.

PR: And I guess, how did you feel like your instruction progressed as the semester went on?

I: I saw a change after three weeks, so I started, I started the semester teaching. Doing like project-based, and then I found out that the students weren't really learning. Or at least they were still kind of confused because they didn't understand the math behind it, and so after three weeks and using the discussion board that started dwindling, I started to focus more on, "OK, let's go through this and let's break it down and work through it

more like you can see a problem completely broken down. You can see all the key steps." Tackling the problem and then what we're gonna do is take those key steps now and then apply it to another problem. So I was just showing them that, and I think that helped. At least my students. Sort of seeing how they could challenge a problem and, and if there is another example of how to do that as far as another way then I would ask them is like if this way is, you know, not effective for you, please let me know, like if you may have another way and we can work through it together. I know I had three students who had that. And I warned them of the the potential, um, the potential challenges for that particular method in that if you do it in this way, you could forget about how units are where the units are coming from. 'cause they did it without units, just math and I was just letting them know it's like, just be careful of this, but it's you can solve any problem in a in multiple different manners.

PR: So, which improvements in your teaching do you think you could directly attribute to the PLC? Or do you feel like the PLC at least helped with?

I: Um. Being transparent with not only students more but with other instructors that actually was the most improvement I've seen in the PLC. Um. As well as…using other teachers' knowledge even. We call this of, you know, how many years they have under their belt to provide experience for helping the students. And that's, that's the main thing is if you've been teaching longer, you have more, much more experience handling a lot of situations. By using situations that work. And then using and…previous, like previous situations, previous strategies that have worked in the past and then trying to see if there is maybe new strategies that could be even as effective. Because it's not just for students to learn it's for the instructor to relay that information that's comfortable for the instructor. Yeah, I think that's the hardest thing is, is seeing other people's perspective.

PR: So do you feel that the PLC helped you evaluate your teaching or change the way that you think about your teaching in any way?

I: Um, immensely it has. That's one area I would love to improve more is how, how do I reflect? Uh. Reflect more, listen more to the students. Rather than, you know, how I feel like I can do it. Getting actual feedback and acting on that feedback that's I think, helped me the most with the PLC that the PLC's helped me realize that even further, is that the students dictate your, you know, your improvement. As a teacher, I've had more students email me with thank you's, more positive encouragement this semester than I've had in the previous two semesters.

PR: Do you feel like it's gonna help you plan for next semester as well? What kind of changes do you anticipate making?

I: Um? Creating a task list. You know, even from not only with our PLC, but even with our, you know meetings with both, you know, yourself and, and [Instructor B] that, creating a task list, looking at it so that way it keeps us organized, so better organization. Um, and then also, using the feedback from the students as well as the other teachers. I'm gonna try and at least go to more classes, review their strategies and also

talk with other instructors more. That's, I think the PLC helped us, helped me, sort of build that connection better. And where I didn't, I don't feel like I was on a tiny little island for the chemistry side and I can talk with other instructors more.

PR: Yeah, so you mean like from the biology side and like where we have more people?

I: Yeah, OK biology. Yeah, definitely biology, A&P.

PR: OK, so I guess, like looking back at the semester, what motivated you to make changes in your instruction?

I: Student feedback. Um, and also seeing the students, as a, like their participation. I can just like, trying to get them more participating but then sort of realizing that it was only one or two key speakers. When I tried doing groups that were talking and then a lot of students were complaining that their team members weren't helping, so listening to that feedback helped really promote me to change how I was teaching this semester.

PR: As the semester went on, do you feel like it had any sort of influence, or was that really just the collaboration part of it?

I: Reflect like reflection, yeah and honestly, having, even, even with contacting [Instructor K] I think that had the most influence for how I was teaching along with, um, at least providing, uh, some insight for how the next semester, uh, could be improved. So without the PLC to be honest I would not have made those connections. So, I think that was the best thing was the PLC helped bring everybody together and help with providing that insight. So that way they can honestly constantly improve together. Rather than on their own.

PR: OK, So what would you identify as having the most impact throughout the process?

I: Um, teacher to teacher communication. That that is probably the most impact, I think. The PLC is had on me at least. I can't say what other instructors, but at least on my standpoint, yeah, that connection and that transparency.

PR: OK, and then final question, would you wanna do it again?

I: Yes, OK. I'm, I'm always an advocate for, as well as, you know, having everyone grow together, share their experiences. Because you may not know all the answers. And other teachers may have experienced that before. Uh. I think it just helps bring everybody together. Um, which will, in turn, bring the department together.

Interview Transcript: Instructor J

Participant-Researcher (PR): The first thing is, what did you enjoy the most about the PLC about our meetings?

Instructor J (J): Well, I guess that the best thing was realizing I'm not the only one. Yeah. Difficulty is we need to change it out, you know, getting everybody's, uh, perspective on, you know, how they are doing things. So without, that was really a major thing for me.

PR: And what did you enjoy the least?

J: Um? I haven't…don't think there was anything, I mean, because most of us…it's hard, but it was important to our teaching. I…I can…Well, I can't remember and I can't say if it was something really that was like, "oh really, oh my God," I would have remembered, you know, but I really don't think there was anything that I did not, per se, enjoy or enjoy the least 'cause, you know, we're able to vent and nag and support each other so I don't, I don't think there was anything that that I enjoyed the least. I can't remember.

PR: So I guess compared to this, what other experiences have you had in the past as like, an organized group of educators?

J: Well, the other experiences that…working…yeah. I really didn't, you know. I mean, as far as doing the meetings, I mean, I know we did like, you know, A&P meetings way back when, but to me this was different because we were online. We have new challenges. We have to come up with new ways of doing things so I would say nothing really…to be this extensive and, you know, helpful. The A&P meetings that we had before, it was just, "do we wanna keep this, do we wanna do that," but this was more helpful on teaching and how to get the students to get engaged, especially in the online classes.

PR: And I guess is that the main difference that you see between those other, you know, like A&P meetings that we had? Or other meetings that we've had in the past? Or can you think of any other differences?

J: Oh. Well, the other meetings were very specific. Good, you know. In these [PLC] meetings chemistry was involved, physics was involved, everybody, you know, have a say even though we're teaching different things. So that, that was helpful. Like the A&P meeting, all we talked about was A&P and what we need to do. By looking at what other classes are doing that, how they are handling the situation. I think that's the big difference between them and the fact that before it was not online and not, you know, I mean, this was…could be changed at different…how to get things to work online

PR: And you kind of answered the second and third question all in one. So I'll throw in another question. What, I guess, what benefit or what downsides do you see to us having met online as opposed to in person like we have in the past?

J: You mean for the meeting or for classes?

PR: For the meetings.

J: Oh. Um? The good thing with the meeting, you know this, this way it is, like I said, just having instructors from different classes. Letting me or us, know you, know how things are working and getting help from them because, I guess, when you only talk to people who teach the same thing, y'all may not be looking at say, outside the box. I just think this is the only way, but when other people, you know, chime in, then it makes a difference. Usually, you know, our division meetings...again, it's been just goals and things like that. I don't think they ever had all of us talking about our classes. How to handle the problems we all face. You know, how to resolve one because the only time all of us ever work together with division meetings and completely different things, it really didn't have much of anything to do with teaching, per se.

PR: So I guess based on this experience, what kind of things did you change in your instruction during the semester? Or maybe not in in your instruction say in class, but just as a as a teacher, what…what things did you change?

J: I literally, every…before every class I usually…'cause the teaching has been more or less the same, you just kind of go over your PowerPoint and go, "OK. These are the main points now." It's literally every single day. Even, like, if I teach a lab on Monday I see something that I could have done and I will change it for Wednesday. It got me to more look at, you know, how I present things and how I can change it really to improve my presentation to get students to, you know, be involved, or engaged or, you know, get the point across…me literally. I was just working on my…You know, even though I taught the lab online last semester, I was just working on my PowerPoint. I change anything back on lecture, you know, before, like, last semester I more or less lecture like I would in a face to face and I, I don't think that was the best. So right now I was working on my PowerPoints for a lecture. I put, like, images that they have to label. So I'll get…you know, like lab I got it to get them to be involved. Lecture not so much. I pretty much lecture but then, now I think, you know, I need to do something different. I don't think my lectures were very good. So right now I was literally working, adding images and things. Get them to, "OK label this. You tell me what this is." You know, things like that, so it's…it's definitely, you know, being online and going through talking to everybody, I think not only on my online lectures will be definitely different. Probably face to face eventually will be a bit different too

PR: So kind of going off topic here and…looking at your survey and, like, what you answered. A lot of the questions that…you decreased in your score, like how you rated yourself, had to do with teaching techniques. So for example, some of the questions that you actually scored yourself lower on were like, "after teaching a point, I asked myself if I teach it more effectively next time." So you scored yourself higher at the beginning of the semester, but lower at the end. Or there was another one, "I know when each teaching technique I use will be most effective," or "I ask myself if I have considered all possible techniques after teaching a point."

J: Well, we could again, you know, going into it, obviously anything, you think you got it and you have done the best. You know what I mean? But then, and by the time…time goes by plus…you know honestly, although we taught online in the summer, but everything was so hectic and there was not a lot of time, and we have so many new adjunct. I said, you know what that means at the beginning. So it's like, OK, "I got this." But then as time went by and the things that I thought I need to do more to get my teaching going kind of was put in the back burner trying to get everybody to catch up to where they are supposed to be. You know what I mean? Like, like in PowerPoint. Sending it to adjunct. Making sure they're gonna do it. I spend a lot of time doing those kinds of things and, and you're going to different adjuncts' classes thinking, so they're doing what that supposed to be doing. Maybe I shouldn't have, but I did, and I think that took away from my own attention to what I was doing. I mean, like I said, you know, right now I'm looking back and going well, "I probably shouldn't have done that," so probably I should get this semester to get students more involved.

PR: So…looking back, how do you feel that our meetings helped? Did you kind of evaluate your teaching or change the way you think about your teaching?

J: Yeah. I'm thinking, I'm thinking, yeah. I'm trying not to repeat myself on what that was I said, but…You know really just….Going to…that's another thing you know. Like, I went to [an adjunct's] class and I saw him making students actually, let's say draw the image of the ear. Like OK, somebody draw the earlobe, somebody draw that…external auditory canal. I thought that was the good thing, you know, and, and so I think that our meetings also gave me this possibility to, you know, watch other people. Now we just did our meetings, but other people that are teaching and try to incorporate things that I want to do this semester and you know, I honestly did not have time to change much of anything for last semester. But…but I learned. I'm incorporating it for this semester's classes.

PR: And, and…what motivated you to make those kinds of changes in your instruction or, and just how you approach your classes and preparation and things?

J: What motivated me? Hah, trying to do a better job. [laughs] I mean, I will, you know, you…you get student evaluations, you watch other people, you just hear what are other people doing; ways to solve problems. So I mean I think all of this or anything that this…I do...has to do with how I can improve my teaching 'cause I don't wanna be, you know, doing the same thing over and over and over and say "well, what the heck it's student's responsibility." I take responsibility for my students if, if they fail so that that's the big thing. Just trying to improve how I present the material and hope that my presentation will help students understanding the concepts. So really more about the, the students. It is. Yeah.

PR: Um, and then, I guess, do you feel like you're gonna plan differently for next semester? Like, do you think you'll continue with making those kinds of changes and things?

J: Yeah, like I said, I literally was doing that.

PR: I feel like I'm asking you the same question over and over again because you're, you're answering the next question as you talk.

J: Yeah, I can't wait.

PR: You did and then I guess, what would you identify as having the most impact throughout the process of our meetings? If you had to pick one thing?

J: You want the honest answer or a good answer? [laughs] That I'm not alone in this thing. I mean honestly, I think for all of us…was that, you know, I'm I'm doing this the right way. Is it working how am I supposed to do it and, and hearing other people are stuggling the same way you're struggling. Not that….I guess is the way you…make you feel good when you…also you know, talking about and think what can we do to change it. You know, I think that that was the big thing, "OK, here's the problem it seems like all of us are having," you know, like keeping students attention in a three hour class. So you know, what are we going to do to change that? How are we going to get them to, you know, be involved?

Just asking a question and sitting there for answer obviously may not be working, so maybe, you know, I don't know, do Kahoot in the middle of the class. Yeah, I mean, just, just, just learning from each other how to solve the problems that we all have. I think everybody struggles trying to get students being engaged. Maybe some more than others, but coming up with a solution. And solution with one class will work and, you do the exact same thing with the next class and shoot! It's not happening. So trying to come up with different way of doing things. For different class that was major and that was time consuming and, you know, in all honestly, tiring, you know. You teach three different labs. And for each of them, you have to come up with a different way of doing it to get them engaged, do something, answer your questions, whatever. That's what I'm saying. You know with lecture last semester I would just ask questions and that really didn't work like one of my, I was reading my evaluations like, "she expects us to everything" and "she…ask questions and when we didn't answer she would say, 'you should know this.'" Now, even just the way I talk, I'm changing that and, and, you know, I thought saying you know, "you should know this" will encourage them to answer me. Obviously not. Because somebody's complaining, so maybe even just the way I not just present the message but the way I ask questions and how I would say things that would be different. I mean literally that thing is just been stuck in my mind since I read my evaluation and I said, "ok how could I say something." You know what that means? Definitely is good. Hopefully It will be better this semester from all the things that I got, like [Instructor D], was saying [he/she] gives them these sheets to fill out and things like that while [he/she] 's teaching. And that's what, yeah, I just did. My chapter one. Uh, putting out these images that while I'm teaching they have to label it now. So and we shall see how that works.

PR: Yeah, and I guess going back to what you said about, um, the, you know, the students and their feedback, and…changing the way that you ask questions and stuff on your questionnaire. You had said something about being more sensitive to students and their situations. And then there was another thing. So being more sensitive to students and being a more compassionate instructor. So was there anything that happened during the semester, or I guess in the PLC, that made you reflect more about that?

J: Well, yes, we were talking about, you know, how, well exams or whenever they are. You miss it and you know [Instructor D] said some one of them, I think, one session [he/she] was doing it. The image that [Instructor K] sent and I can't remember what it…But now you, like, you know. Should we treat everybody the same? The same meaning, you know, I don't know, "your mother died… tough luck, too bad, this is the exam time," or you know, "your child is sick in the hospital… oh wow," you know whatever. So yeah, I, I think about that meeting. I think I'm a…I want to follow the rules and I always have, but definitely at this time and yeah, talking to other instructors like, well maybe being a little bit flexible. Is better evaluating each situation instead of a blanket going, "well it is what it is and when, you know, tough luck, too bad."

PR: Yeah, and was that that conversation that day that we had about like, um, how did somebody say it? About like giving grace, but not you know, bending rules for people?

J: Right, right? And then it says that there was something that [Instructor D] sent…the email. I can't remember it. Just sent this picture, you know, equality or, what was it?

PR: Equity.

J: Equity right? It could be that image really just still stuck in my head, you know, equality giving everybody the same thing, but does that really help everybody? Yeah, and that image I think more than anything else and so stuck in my head that the, you know, that it might sound good and, but this really doesn't look good when you get result is not that good. You know what I mean? When you want to treat everybody exactly the same and not think about all the different situations. So that was one of the big, big things, really like I said, even the wording wasn't as much the greatest thing for me than the image that [Instructor K] sent. Yeah I don't know if you remember or not.

PR: Yeah, 'cause that, I mean, that's definitely hit home with me, too. Because then it like, I really started thinking about like, our, our policies, you know. Are they fair? Are they, you know, making some students...are they putting some students at a disadvantage compared to others? And in making sure that everybody is actually being treated…fairly and not…being automatically put at a disadvantage for some reason you know it's going to impact their success in the course.

J: I don't know…I guess that….But they say it image speaks a thousand words or whatever, you know. We talked about it, [Instructor D] wrote a Very nice email about it,

all of that …nothing impacted me more than that image. And it's like, and I guess that was one of the things you, know ,being, trying to be in more understanding and compassionate, uh, towards students and not just go, "oh, this is the policy and tough luck too bad."

PR: Yeah, well, and I think that was pretty early in this in this semester and I think that's about the time too that we decided to have, you know, like the committee for reviewing tests. You know, as opposed to just being like, "oh well, too bad."

J: Yeah I mean, you know that was one of the things so. Coming up with that and not trying to just make the decision by yourself. And you know, so, yeah, I, I think, you know, I don't know about anybody else, but I did get, I think, a lot out of those meetings. I mean I. I enjoyed it. Like I said I guess because it was all of us talking at the same time instead of just A&P or just, you know, I don't know chemistry or just microbiology or whatever.

PR: Yeah, well it was funny is like last semester [Instructor B] and [Instructor I] had the same issues with [the learning management system] that it sounds like you are having now. Sorry.

J: Right! Just like I said, you know, it's because you feel like, "oh my God, I'm the only one." Oh I mean, you know, whatever, not that, you know, there's joy in other people's misery, bBut then it makes you feel like, "OK, I'm not the only one," and, and just trying to figure it out together. "OK. What did you do?" And again because it's different classes I think that was the big deal in making a difference, you know, even like I would ask you something and you go, "well get [Instructor K] and [Instructor B] and [Instructor I] involved because they may have a different perspective." You know, before it wouldn't even cross my mind. I'm like, well, they're not teaching A&P so they're not going to understand. But then when you brought it and got them into a conversation, yeah it was somebody looking from outside and going, "well, let's look at it this way," so.

PR: So you kinda already answered the last question, but would you do it again?

J: Yeah, definitely, definitely. I really I think it was, like I said, for me it was helpful for me that personally, I don't know…about anybody else. But I think for me it hit home. You know, few things that I think is important and I probably will do differently this semester that I did last semester.

Face to face classes was a challenge. You know, with a mask on you know you ask your question, you couldn't see who's answering you. You couldn't see, I mean, the facial expressions, but when, when I teach face to face, you know, and I look like, OK, more than half the class have no idea what I'm talking about, so let me redo this. But with this masks on and everything you can't see, yeah you can't understand, you know, are you getting the whole point across? Or you asking question and you hear these muffled sounds? You don't know how many people are answering you, but you know what, it really was a challenge. It was like. How do I get this to work?

PR: So, so it's like the things that you, the things that you used to know to be able to do no longer worked anymore.

J: Right, right? And it's just trying to really, you know, figure it out. I mean I don't know what I wrote. I do think, yeah, I, I know I think I got, you know, I think about this an hour before class or whatever after class. But really it's almost a 24 hour thing. You know, it's like, what do I do? How do I make it work when it, you know, so, I mean, a lot of back and forth in my…I have met [Instructor A], I don't know, you know, how many times now? As far as just coming up, you know, with things to do for A&P one, so I, I got a lot out of it and I think it was very helpful. I guess that I enjoyed it a lot more than I did the book club

PR: Yeah, well, if everybody is on board, will keep doing it.

J: I mean, I, I like I could…even just venting to each other, you know.

PR: Yeah, that that's helpful. Yeah, I think as long as the venting actually turns into something you know, like, in doing something about it, instead of just venting for the sake of venting. What are your thoughts on that?

J: Right, and I think eventually and usually it will, because when you're ranting about it and realizing everybody is in the same boat like OK, now what do we do? Or you vent and you realize you're the only one, right, this problem and you have to look back and go, OK. What do I need to do? Why am I the only person that this thing doesn't work for, you know what I mean? I think it either way when they collectively come up with an answer. Or personally, this is like. Oops! I'm the only one with. This problem, so yeah, let me see how everybody else is doing it.

PR: So would you say in in like situations like that like it gave you an opportunity to reflect a little bit, like on yourself?

J: Not only that…that, that's what I'm saying. You know it's, it's, if I'm the only one having a problem, whatever it is, then it's me not being able to do what I'm supposed to be doing, and it's not, you know, it's not the student, is not, you know. It's, it's, it's definitely something about me, but I gotta change it I mean. Well, yeah, I guess even reading those surveys is, and I thought I was being very nice and saying, "oh come on guys, you gotta know this obviously." Was not the right way of saying it or doing it. Anyways. Yeah. This is tough. Let me tell you teaching is not as easy as I thought it would be.

Interview Transcript: Instructor K

Participant-Researcher (PR): What did you enjoy the most from the PLC?

Instructor K (K): I always enjoy the chance to get together with other people and get different perspectives on various issues.

PR: OK, and can you give an example of something from this semester that would fall into that category?

K: Oh, when we were talking about the testing time. Like, rotating the testing times and things like that. It was interesting to see the various perspectives that people had and how strongly some people felt about it and how others didn't feel like it was really an issue.

PR: OK, and what was something that you enjoyed the least? Or you did not enjoy?

K: Spending all the time on the testing time switch. I personally don't think it's that important, and so it was interesting to see other people's perspective. I mean, I guess the mathematical part of me…you're just shifting the hours. I don't know. It seems like we're trying to rearrange things for the students who have the most propensity to put things down to the last minute and then whine about the consequences. My personal opinion.

PR: OK. And so I guess with all of your experience, this is kind of a loaded question here. What other experiences have you had as part of an organized group of educators?

K: In my whole career?

PR: Maybe we should narrow it down.

K: Uh huh. The book studies have been effective I thought. I have been part of the mentoring program and that's been helpful as well.

PR: So what benefits did you gain from the book study? And from mentoring.

K: The chance to reflect on what I do and why I do it that way, and to have other people kind of give me new ideas on how I might approach things. So at least it's making me more intentional about what I'm doing. And I think anytime you can…you always want to make the best decision given the information you have. So if you have more information then you can make a better decision.

PR: OK….And…How was the experience of the PLC…the virtual hall meetings…different from those things like the book study and from mentoring?

K: The book study was only focused on one particular topic. And it was a topic that the author had generated and we were responding to it. The hall meeting was the issues that we generated. And I think that's where it really had a lot of importance for me.

PR: Ok. And I guess this time on this semester, do you feel like during the semester you're instruction and improved at all, or changed as the semester progressed?

K: I don't know that my instruction improved because I was doing the online. But I think my understanding of how I needed to do online instruction improved. That makes sense?

PR: Yeah, yeah, that does. Um, and with those improvements that you made, or your understanding that you got, what…can you attribute any of that to the PLC, and if so, what?

K: I think so. I think listening to other people talk about how they approach their classes and working through various issues that students have was helpful. Even though the way students approach anatomy and physiology is very different from the way they approach physics, the fact that I deal with a lot of students that are in A&P made me realize that it might not hurt me in the online situation to be a little more like the A&P so that it would fit a little more to their comfort zone.

PR: And can you give an example of that?

K: Well, I think, like I've always allowed late work. And although in our physics meeting we had decided to continue to allow late work, I'm really thinking that we should not allow it. So probably beginning next fall, we're gonna go into a shift where we don't allow late work, but we're gonna look at maybe some more options? 'cause right now we don't have a lot of options. And so what I want to do is to give students…three equivalent assignments. You take one of the three to do. And one would be more of an essay type approach, one would be more of a simulation analysis approach, and then one would be more mathematical.

PR: So I guess since you didn't really like feel like it helps that much with your actual online instruction, do you feel that it helps you with planning for next semester?

K: Oh absolutely. I was just, I guess the reason it did not help with my actual instruction. [pause] I like things to be very, I don't know that regimented is the right word, but I like a routine. I think students do better when they know what to expect. And I hate to break that routine in the middle of a semester and start changing things.

PR: OK, that makes sense. So I guess looking back though. Do you feel that like the PLC helps you evaluate your teaching or change how you think about your teaching for next time?

K: Oh. Yeah, yeah, it always challenges me when people discuss issues and how to approach them and I try to understand all of the various approaches and how they arrived at that particular preference. So it helps me become more aware of not only my own style and my own preferences, but the adjuncts that I work with. And if I'm trying to prepare a course that can be effective and there are three different instructors, then I need to be aware of how the different instructors approach things as well. So as a course manager I can't just…I set the course up according to my own preference. I have to be aware of other people's preferences, but I think the PLC also helped me get a better understanding of, in some ways, of how the students are reacting to things…maybe reflect a little more on that.

PR: OK, can you give an example of that?

K: I am very structured in the way that I have set up my homework and my problem set in the labs and things like that. I think the PLC helps me understand that even though I think that structure is good, there are students who struggle with understanding the structure. And so I have to do a better job or a more thorough job at the beginning of the semester, making sure that we focus on the structure instead of the particular details of the content. If that makes sense.

PR: Yeah, that makes sense. And you know you mentioned too, like work, the way that you're gonna be working with adjuncts and stuff. Do you anticipate from the PLC changing the way that you work with other people?

K: Um, a little bit. But I'm so deep into my career and I've been doing this for so long that I think most of the major shifts that I'm going to make have already been made. I think now I'm into more fine-tuning. Um, I don't know if that's a matter of being an old dog and new tricks or that I have taken 40 years to become to grow into that. The way that I like to teach and the way I think is more effective for me in my personality, and so I don't see major changes.

PR: So let's see, I lost track of where I was in my question…what's been the main motivation to make changes in your instruction or changes in your course. I think you touched on that a little bit.

K: It's always trying to help students prepare. Um, I truly am much happier an instructor at [the Technical College] than I was in the high school system, because the technical college isfocused on what I call real education, getting students to understand real knowledge that they need for their job and their career so they can be successful.

PR: OK, and I guess what would you identify as having the most impact through the process? Of the PLC?

K: Personally? I think the time between meetings when we had questions on the table that we needed to reflect on it come back to. I think I rarely have my best thoughts within the confines of a meeting. I think if we address an issue, talk about some ideas, and then

go back and come back in in a week or two and give people a chance to process it and really think through it, I think we get better. Better ideas I guess.

PR: OK, so trying to…almost like a task or something to ponder upon before the next meeting.

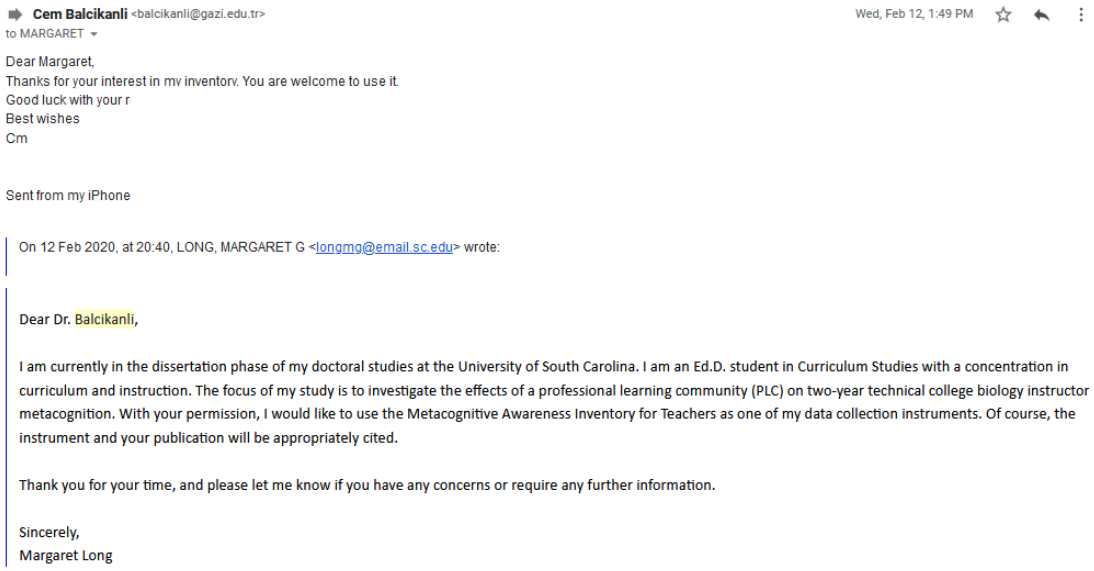
K: Yeah, and I I'm a very reflective person anyway, so even if we're not given a task, I tend to reflect on what was discussed and then grow from there, probably. After two or three days I'll have some insight. I'll have settled on something or created a new insight or something that kind of helps me feel better about my perspective on that issue.

PR: So my final question is, would you want to do the PLC again?

K: Yeah. I always want to do more of those kinds of things. I think that's probably the most…helpful thing that we as a group can do. Particularly because we deal with so many different students. And I know that as, you know, A&P teachers y'all meet periodically, but that's so focused on A&P that I think sometimes we lose sight of the bigger picture. For that I think the PLC is really advantageous.

APPENDIX G

PERMISSION TO USE THE MAIT



Cem Balcikanli <balcikanli@gazi.edu.tr> Wed, Feb 12, 1:49 PM

to MARGARET

Dear Margaret,
Thanks for your interest in my inventory. You are welcome to use it.
Good luck with your r
Best wishes
Cm

Sent from my iPhone

On 12 Feb 2020, at 20:40, LONG, MARGARET G <longmg@email.sc.edu> wrote:

Dear Dr. Balcikanli,

I am currently in the dissertation phase of my doctoral studies at the University of South Carolina. I am an Ed.D. student in Curriculum Studies with a concentration in curriculum and instruction. The focus of my study is to investigate the effects of a professional learning community (PLC) on two-year technical college biology instructor metacognition. With your permission, I would like to use the Metacognitive Awareness Inventory for Teachers as one of my data collection instruments. Of course, the instrument and your publication will be appropriately cited.

Thank you for your time, and please let me know if you have any concerns or require any further information.

Sincerely,
Margaret Long

APPENDIX H

EXAMPLE LETTER OF ASSENT

Dear [Colleague],

My name is Margaret Long. I am a graduate student in the Education Department at the University of South Carolina. I am conducting a research study as part of the requirements of my degree in Curriculum & Instruction, and I would like to invite you to participate.

I am studying the effect of Professional Learning Communities (PLCs) on instructor metacognition (defined as "thinking about thinking"). If you decide to participate, you will be asked to complete surveys about metacognition and questionnaires about PLCs. You may be asked to participate in an interview about your experience in the PLC. In particular, you will be asked questions about your own instructional practices and experience within the PLC. You do not have to answer any questions that you do not wish to answer. The PLC meetings will take place virtually for a total of six times throughout the Fall 2020 semester, and each meeting should last about 30 minutes.

Participation is confidential. Study information will be kept in a secure location at [redacted] Technical College. The results of the study may be published or presented at professional meetings, but your identity will not be revealed. Each participant's data will be assigned a pseudonym so that survey, questionnaire, and interview answers are de-identified.

I will be happy to answer any questions you have about the study. You may contact me at XXX-XXX-XXXX or by email at XXXXXX@email.sc.edu or my faculty advisor, Dr. Yasha Jones-Becton (XXXXXXX@mailbox.sc.edu).

Thank you for your consideration. If you would like to participate, please complete the attached survey and return it to me.

With kind regards,

Margaret G. Long
XXX-XXX-XXXX
XXXXXX@email.sc.edu