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Analysis of the Impact of Professional Learning Teams on Teaching Practices and Student Achievement in Biology Using Dufour's Model

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ANALYSIS OF THE IMPACT OF PROFESSIONAL LEARNING TEAMS ON TEACHING PRACTICES AND STUDENT ACHIEVEMENT IN BIOLOGY USING DUFOUR'S MODEL

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Abstract

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This mixed-methods study addresses the perceived impact of working in Professional Learning Teams (PLTs) on teaching practices and student achievement in biology. The study replicates Roberts's (2010) study. Success in biology is important to the nation because it aligns with national efforts to prepare students to compete in global markets. Educators use PLTs to support development of educators and address student educational needs. PLTs share basic functions. Basic functions were defined using DuFour's (2004) three big ideas of PLCs: ensuring students learn at high levels, promoting a collaborative culture, and focusing on academic results. Biology teachers completed an anonymous online survey with Likert scale and open-ended questions. Results were analyzed using statistics and theme verification. Results were compared against student achievement measured by school Grade Level Proficiency (GLP) percentages on a summative state biology test. Results were compared to Roberts's (2010) results and showed teachers' strengths in knowing objectives and deciding on essential outcomes based on state and district standards. Findings show teachers believe work in PLTs has positive impacts on teaching practices. Some teachers believe negative impacts accompany the positive impacts. Most teachers feel skilled in ensuring students learn at high levels. Findings show PLTs in schools with high GLP percentages clarify norms. PLTs in schools with medium GLP percentages discuss evidence of student progress at each meeting.

Implications for practice include meeting teacher professional learning needs to provide optimal learning to student subgroups. Recommendations include replication for all science courses and other districts.

Keywords: professional learning community/team (PLC) (PLT), Dufour's three big ideas, biology student achievement, grade level proficiency (GLP) percentage, high school biology teachers

Table of Contents

Page

Chapter 1: Introduction

Team collaboration strengthens the core functions of organizations. Members of the team hold each other accountable to standards and educate each other elevating the efficiency and consistency within the organization (Fullan, 2001; Morgan, 2006). The same idea is true in educational institutions (Danielson, 2006; Graham & Ferriter, 2010; Hall & Hord, 2015). Educators within and across educational institutions collaborate to improve conditions in schools, enhance educator effectiveness, and advance student outcomes. In education, one type of collaborative team is the professional learning team (PLT) also referred to as the professional learning community (PLC).

According to DuFour et al. (2010), PLTs "impact [teacher] classroom practice in ways that will lead to better results for their students, for their team, and for their school" (p. 12). PLTs use school and student data to identify and address academic needs (DuFour, 2004). PLTs track and compare data among student subgroups to work towards equitable learning for all student groups. In North Carolina, the host state for this research study, the North Carolina Department of Public Instruction (DPI) prioritizes PLT involvement as a tool to improve student achievement. NCDPI holds educators accountable for their input in PLTs to improve the quality of instruction and achievement for every student. NCDPI requires annual educator evaluations and hosts a biennial survey monitoring PLT activity and development for districts, schools, and individual educators. The evaluations and survey help ensure PLTs are functional in public school systems to promote consistent academic success for all students.

Background Literature

Developing effective, successful PLTs is a process. PLTs develop in phases as

members leave their comfort zones of working in isolation to embrace a mindset of shared responsibility and mutual trust (Danielson, 2006; DuFour et al., 2010; Graham & Ferriter, 2010). As educational PLT members work to share their skillsets, to reflect on their practices, and to disaggregate student data, they increase their collective knowledge allowing the group to better identify and address deficits in student learning for their student population (Danielson, 2006; DuFour, 2004; DuFour et al., 2010; Graham & Ferriter, 2010). Congenial relationships among members in a PLT gradually transform into collegial relationships (Graham & Ferriter, 2010) as members synchronize their tactics to respond to student academic needs (DuFour, 2004). The change in school culture that accompanies PLT development is often drastic and uncomfortable, requiring educators to be vulnerable and transparent to their peers as they examine student data (Gruenert & Whitaker, 2015). Teacher leaders and administrators, who keep the PLT focused on student learning and results, play a vital role in a PLT's success. Trained school leaders strengthen PLT functions within their educational institution, direct the focus of the PLT, and troubleshot problems (Danielson, 2006; DuFour et al., 2010; Graham & Ferriter, 2010). PLT function is especially important in science courses.

Achievement in science is important to the economic growth and competitive edge of the nation (Friedman & Mandelbaum, 2011). Educators and business leaders work together to create initiative to increase 21st century science, technology, engineering, and math (STEM) learning. Training in science prepares students for the needs in the job market and positions students to develop innovative ideas. Success in science courses supports success in other disciplines as the underlying principles and analytical thinking extended into other disciplines. Biological science, or simply biology,

which is offered in the first years of secondary education plays a special role in continued development of integrative and analytical thinking. High achievement in biology supports success in advanced sciences and other advanced courses. Since deficiencies in science education affect the national economy, research on factors that affect achievement are important. For this reason, I studied associations between teacher perceptions of biology PLTs and biology student achievement. PLTs have been shown to affect student achievement, but the literature lacks specific information on biology PLTs.

Statement of the Problem

Instruments such as state educator surveys provide data on teacher perceptions of PLT functions, but they do not offer reports for individual subject areas. One discipline area lacking in research is an evaluation of biology teacher perceptions of their skills that "ensure students learn(Dufour, 2004, p. 6), of their PLT's skill to "promote a culture of collaboration" (Dufour, 2004, p. 7), and of their PLT's "focus on (academic) results" (Dufour, 2004, p. 7). Data from this type of evaluation could help school districts understand the areas of need and strength in biology PLTs and could better equip school district and school leaders to facilitate the development of biology PLTs. These data are also useful to create effective and individualized support for instructors to support improvements in student learning (Drago-Severson, 2009; Hall & Hord, 2015). Student learning in biology across the state needs improvement due to significant achievement gaps among student subgroups and among schools (NCDPI, 2017).

Extension of a Previous Study

I used the research design, conceptual framework, and methodology from Roberts's (2010) dissertation, *Improving Student Achievement Through Professional*

Learning Communities. This research study was an extension of Roberts's research on PLCs. An extension of a study is a type of replication in which a researcher alters components of the original study to reflect the focus and context of their own study (Lund Research Ltd., 2012). The alterations in an extension study can make the study unique and can make unique additions to existing bodies of knowledge about the topic (Lund Research Ltd., 2012). In replicated studies, researchers duplicate the study and compare the original results to their own results (Lund Research Ltd, 2012).

In her research study, Roberts (2010) looked for connections between teacher ratings of PLT ability and student learning in English/language arts or math using DuFour's (2004) three "'big ideas' that represented the core principles of professional learning [teams]" (p. 6). Dufour's first big idea was "ensuring that students learn"; his second big idea was creating a "culture of collaboration"; and his third big idea was "focusing on results" (p. 6). In Roberts's study, teachers took a survey to rate their personal skills in "assuring that all students learn at high levels" (p. 7), to rate their PLT's skills in "creating a culture of collaboration" (p. 7) and to rate their PLT in "focusing on academic results" (p. 7). Teachers participating in the research study were elementary, middle, and high school teachers who taught English/language arts or math in a midwestern school district. Teacher perceptions were compared to student achievement scores. Roberts tested for correlations between achievement and perceptions of PLTs.

In the same vein as Roberts's (2010) research, I looked for connections between teacher perception data on DuFour's (2004) three big ideas and biology achievement data. I collected reported achievement data in the form of biology Grade Level Proficiency (GLP) percentages and reported them by ranges. Biology teachers in one

school district in North Carolina participated in the research study. Participants were teachers who taught a high school biology in the Community Relationships (CR) school district (pseudonym) in the 2018-2019 school year. Approximately, 45 teachers taught biology in the 2018-2019 school year. Sixteen teachers participated in the research study.

Roberts (2010) conducted a convergent, mixed methods research study collecting quantitative data and qualitative data simultaneously, analyzed the data separately, and then merged the results of the analyses (Creswell, 2014). Mixed methods research serves to glean the benefits from both types of data and provide a more detailed understanding of the results (Creswell, 2014). Roberts collected perceptual data through an electronic survey distributed via the school district email system. The cross-sectional survey contained Likert scale questions to collect quantitative data and open-ended questions to record qualitative data. Roberts's (2010) used a pilot study "to check the validity of the survey by making sure the individual scores gathered from the instrument allowed [Roberts] to 'draw meaningful and useful inferences from the scores' [(Creswell, 2009, p. 149)] from the sample being studied to the population" (p. 40). "The data obtained from [Roberts's] pilot study was also used to check the reliability of the survey determining the consistency of questions and responses across all constructs (Creswell, 2009)" (Roberts, 2010, p. 40). Roberts weighted each answer to the Likert scale and calculated the mean and standard deviation of the results. Roberts "sought open-ended feedback" (p. 40) from participants in the pilot study "to eliminate any concerns of bias in the survey" (p. 40).

I used the same design as Roberts (2010)—a convergent, mixed-method design. I collected both quantitative and qualitative data to fill in gaps of understanding in quantitative data using qualitative data (Creswell, 2014). Using a combination of

quantitative and qualitative data increased the depth of the study in that it invited participants to weigh in on the questions of the researcher while expressing their views in their own voice. I used a cross-sectional, electronic survey to collect qualitative and quantitative data of teacher perceptions. Cross-sectional surveys gather information "at one point in time" (Creswell, 2014, p. 157). Surveys allow a researcher to collect large amounts of data more quickly (Creswell, 2014, p. 157). I distributed the survey via the CR school district email system.

Roberts (2010) studied elementary, middle, and high school students and teachers from a district in the Midwest. Roberts studied teachers of English language arts and math and students who took the courses. Roberts used district criterion-referenced tests in English language arts and math created by local teachers.

I conducted a context-driven extension (Lund Research Ltd., 2012) of Roberts's (2010) study. The research study is a context-driven extension because it adapts to the needs and characteristics of a different target population than the original study (Lund Research Ltd., 2012). The population for the research study included teachers who taught high school level biology in a North Carolina school district. I used student data from the state summative test for biology. The state summative test is both criterion and norm referenced. This extension of Roberts's study fulfills Roberts's recommendation that the same study "could be conducted in other school districts that have implemented Professional Learning [Teams]" (p. 132).

Justification for Extending Roberts's (2010) Study

The first justification for extending Roberts's (2010) study of PLTs is testing the generalizability (Lund Research Ltd., 2012) of Roberts's study results. Extending

Roberts's study helps to further examine whether results for PLTs are consistent across different subjects, populations, and disciplines. Perceptions about PLTs for biology in the high schools in the school district serving as the focus for this study may have different associations with student achievement than Roberts's population of teachers and students in K-12 schools in a midwestern school district. Differences in the association of perceived PLT ability with student achievement test the generalization of Roberts's findings across subjects and populations.

A second justification for extending Roberts's (2010) study of PLTs is adding to the literature (Creswell, 2014; Lund Research Ltd., 2012) about PLTs. Extending Roberts's study increases information about connections between teacher perceptions of PLT skills and student achievement. Furthering the research may help the CR district understand the skills of PLTs in biology.

A third justification for extending Roberts's (2010) study of PLTs is to potentially add to the understanding of the original study (Lund Research Ltd., 2012). Roberts recommended replicating the study in other districts to possibly confirm the original results. Replicated studies could test new aspects of the original study which could increase the comprehension of the results (Lund Research Ltd., 2012).

Research Questions

This research study was an extension of Roberts's (2010) research on PLCs. An extension is a type of replication of a study (Lund Research Ltd., 2012). Roberts's central question was, "Do educator perceptions of their personal skill level in working collaboratively and focusing on academic results while implementing a Professional Learning Communities have an effect on student achievement?" (p. 7). I revised

Roberts's central question for the CR district. My central research question was, "How has student achievement been impacted when educators worked in PLTs?" My supporting research questions were

1. How do biology teachers perceive their personal skill level in assuring that all students learn at high levels?
2. How do biology teachers perceive their PLT's skill level in creating a culture of collaboration?
3. How do biology teachers perceive their PLT's skill level in focusing on academic results?
4. To what extent do biology teachers believe their teaching practices have been impacted as a result of working in PLTs?
5. What is the association between teacher perceptions of PLTs and student achievement in biology?

Supporting Questions 1-3 were replicas of Roberts supporting questions except for the substitution of the word "educators" with the term "biology teachers" and the substitution of the word "communities" with the term "team" in each sentence. Roberts used Supporting Question 4, "What percentage of Professional Learning Teams meet their SMART goals?" (p. 7), which used Eaker et al.'s (2002) definition of "Strategic, Specific, Measurable, Attainable, Results-oriented, and Timebound" (SMART) goals. I changed Question 4 to adapt the study to the CR district. Although the CR district used SMART goals, the goals are constantly tweaked according to identified needs of students and instructors. PLT members may not have had an accurate picture of the completion of goals as the goals constantly evolved. Instead, I asked participants a direct question about

their rating of the level of impact and type of impact that work in a PLT has had on their teaching practices. Roberts's Supporting Question 5 was, "Have student achievement scores increased while working within Professional Learning Communities" (p. 7). I omitted the question because the data used for the study is over 1 school year and there is no comparison to another school year. Roberts's Supporting Question 6 was, "Is there a relationship between educator perceptions of Professional Learning Communities and student achievement" (p. 8). I revised the supporting question by replacing the word "educator" with "teacher," changing the word "communities" to "teams," changing "relationships" to "associations," and adding the phrase "in biology," to the end of the question. The supporting question read, "What is the association between teacher perceptions of Professional Learning Teams and student achievement in biology?" I used perceptual data from teacher surveys and test data from GLP percentages for state summative biology tests. The data informed the central and supporting research questions.

Theoretical Framework

This research study was a convergent, mixed methods research study using postpositivism as the theoretical framework. Postpositivism is a "deterministic philosophy in which causes (probably) determined effects or outcomes" (Creswell, 2014, p. 7). Researchers describe relationships among studied factors. "Problems studied by postpositivists reflect the need to identify and assess causes that influence outcomes, such as is found in experiments" (Creswell, 2014, p. 7). Researchers use systematic methods to gather information to address questions, then analyze the information to answer the questions (Butin, 2010; Creswell, 2014). Researchers understand that current truth is

fluid, meaning the current truth could change according to research results (Creswell, 2014; Fischer, 1998). Research results could support or disprove previously accepted cause-effect relationships (Creswell, 2014). In addition to a theoretical framework, I used a conceptual framework from Roberts's (2010) study.

Conceptual Framework

I used DuFour's (2004) three big ideas about PLTs as the conceptual framework. Roberts (2010) also used DuFour's big ideas as the conceptual framework. DuFour's three big ideas, or three central characteristics, for PLTs are "helping all students achieve at a high level" (p. 6), "promoting a culture of collaboration" (p. 8), and "focusing on results" (p. 8). DuFour challenged all educators to embrace the mindset that all students can learn (DuFour & DuFour, 2012; DuFour et al., 2010; Graham & Ferriter, 2010). With this mindset, educators push to find and develop avenues and resources to make sure all students have support to maximize their learning. The most effective scenarios involve educators working collectively to address student learning needs using data to track progress.

A collaborative approach to supporting students in its most effective form allows team members to teach each other and to learn from each other. The result of building collegial relationships and valuing each member and their contributions to the PLT is an organization that is greater than the sum of its parts (DuFour, 2004; DuFour & DuFour, 2012; DuFour et al., 2010; Hall & Hord, 2015). The team takes advantage of the strengths and knowledge of each member. DuFour (2004) reiterated the value of teachers coming out of the isolation that teachers historically embraced to accept a new model of accountability and coordinated efforts with peers. The collaborative culture supports

learning for teachers and students. In PLT collaboration, teachers use a results-oriented approach and use data to track student progress.

Effective PLT work involves a change from "a focus on teaching to a focus on learning" (DuFour, 2004, p. 6). In the past, educational leaders focused on education reforms that trained instructors on new strategies and approaches to convey content to students. The reforms are missing a results-oriented approach where teachers continually use student data as a tool to show the progress of students (DuFour et al., 2010; DuFour, 2004). This approach is a significant change from the traditional mindset in the field of educational leaders (DuFour, 2004; DuFour & DuFour, 2012; DuFour et al., 2010; Graham & Ferriter, 2010). Using student data to identify student needs and track student learning is the central purpose of PLT work (DuFour, 2004; DuFour et al., 2010; DuFour & DuFour, 2012; Graham & Ferriter, 2010). I collected teacher perceptions of skills related to each of DuFour's (2004) big ideas.

Nature of the Study

This research study was an extension of Roberts's (2010) study and used a convergent, mixed methods design to take advantage of quantitative data and qualitative data. An extension study is a type of replication of a study (Lund Research Ltd., 2012). Studies that use a postpositivist framework lend themselves to a mixed methods design (Butin, 2010). I used a modified form of Roberts's teacher survey which I discuss in Chapter 3. The teacher survey included Likert scale and open-ended questions, so I collected quantitative and qualitative data concurrently. In the survey, biology teachers offered their own interpretation and description of personal skill level in ensuring students learned and their weekly PLT's fidelity in collaborating with peers and focusing

on the results. I mined biology student achievement data in the form of GLP percentages and reported the percentages by ranges.

Variables

The research study was a replication of Roberts's (2010) study of PLTs. Like Roberts, I examined teacher perceptions of their effectiveness in affecting student learning and their PLT's effectiveness in teaming with peers and remaining results oriented. In the research study, the independent variables were teacher perceptions of their personal skill level in ensuring students learn, of their PLT's fidelity in creating a collaborative culture, and of the PLT's skill in focusing on student results. The dependent variable was student achievement represented in biology state summative GLP percentages per school. I used information from the demographic information to describe and compare the results. Participant demographic data were the schools where they taught biology in the 2018-2019 school year.

Definitions

I extended Roberts's (2010) study, *Improving Student Achievement Through Professional Learning Communities*. I used the terms in Roberts's study that applied to the extension study and added new definitions that were appropriate for the extension study. Roberts used the phrase PLC to denote the educational learning team that was the focal point of the study. I used the phrase PLT in place of the phrase PLC to remain consistent with the terminology used in the CR district. In this research study, the phrases PLC and PLT were synonymous.

Collaboration

A process when members of a team "work interdependently to achieve common

goals" (Roberts, 2010, p. 8).

Norm-Referenced Test

Standardized tests that compare a student's performance to the performance of other students who tested within the same time parameters.

Criterion-Referenced Tests

"Standardized tests that compare a student's performance to clearly identified learning tasks or skill levels. The basis for comparison is to a body of content knowledge and skills" (Roberts, 2010, p. 8).

Student Achievement

Data from biology state summative tests reported as the percentage of students at a school who scored at or above GLP. Schools are grouped within GLP percentage ranges. Schools within the low GLP range had <5-33% of students scoring at or above GLP. Schools within the medium GLP range had 45-65% of students scoring at or above GLP. Schools within the high GLP range had 80->95% of students scoring at or above GLP.

PLT

"A small team of teachers committed to meeting regularly, working collaboratively on shared goals in order to improve achievement for each individual student they serve" (Roberts, 2010, p. 8).

Grade Level Proficient Proficiency Level

Students are categorized as grade level proficient on the summative state test if they score at least a Level 3 achievement level (NCDPI, 2014). "Students performing at this level [three] have a sufficient command of knowledge and skills contained in the NC

Standard Course of Study" (NCDPI, 2014, p. 2) for the subject.

Assumptions

I extended Roberts's (2010) study by replicating the study in another setting with a different population. I used assumptions from Roberts's study and adapted assumptions as needed for the characteristics of the target population. I made three assumptions in the extension study, namely, "Each participant is an active member of an ongoing professional learning [team]" (Roberts, 2010, p. 9) for the biology course, "Participants will answer the survey [items] about their [PLT] perceptions truthfully" (Roberts, 2010, p. 9), and "Participants are familiar enough with the [PLT] process to answer the survey [items]" (Roberts, 2010, p. 9).

Scope and Delimitations

I replicated Roberts's (2010) study by extending the study in a setting and population that is different from the original study. I used the delimitations from Roberts study and modified the delimitations as necessary for the setting and population of the replicated study. Delimitations in a research study indicate the boundaries of a research study. I used five delimitations, namely, "Subjects include only teachers from one school district who have worked within the [PLT] process" (Roberts, 2010, p. 9), the population for this study consists of high school educators who teach biology and the students who took the same course, "Teachers participating in this study are required to participate in [PLT] training and to fully participate in [PLT] team meetings" (Roberts, 2010, p. 10), "Participation in this study is voluntary" (Roberts, 2010, p. 10), and teachers taught biology for at least one semester during the 2018-2019 school year.

Significance of the Study

Findings from this study add to the body of information concerning PLTs. Audiences who may be interested in this study include senior district staff, program directors, administrators, PLT facilitators, department chairpersons, and teachers. School district and school administrators may be interested in the results of the study as a source of information and another perspective of PLTs to improve the function of PLTs for biology teachers. School and school districts may be interested in the study as a tool to increase their state report card score by increasing support for biology teachers and students.

Summary

The focus of this study was the possible connection between teacher perceptions of PLT skill levels and student academic achievement. Chapter 1 was an introduction to the study presenting the basic elements of the study. In Chapter 1, I explained background information, defined key terms, stated the problem and purpose, presented the research questions, described the framework of the study, and discussed the importance of science.

Chapter 2 is the literature review of the research study. In the literature review, I explain the origin of PLTs within the business sector, the three big ideas (DuFour, 2004), and the function of PLTs in the education sector. Within Chapter 2, I elaborate on the frameworks used in the study and explore the origin of PLTs through Senge's (2006) work.

In Chapter 3, I explain the methodology with details of the procedures in the study. In Chapter 3, I expound on the alignment with the original study (Roberts, 2010), the data analysis, my input, and the ethics of the study. I explain the procedures for

collection and analysis of data from the survey and from test data sources.

Chapter 2: Literature Review

Introduction

PLTs support the mission of educational institutions to meet the academic needs of all students and to increase achievement among all student subgroups using data analysis and team efforts. PLTs focus the work and progress of education professionals to create a synergistic flow of new ideas and differential applications of strategies to address student needs in individual classrooms. Each member of the PLT is a valuable link in the success of PLTs to positively impact learning for students and teachers.

In the characteristic PLT model, the PLT members share their weaknesses and strengths openly so the PLT can identify ways to support each teacher in their professional growth and define ways for each member to be an active part of the group. Historically, the open nature of PLTs is the vulnerability that must be present, along with mutual respect and positive will towards each other, to establish a foundation of hope that the PLT will be effective. In times past, the mentality of educators to create such intimate teams was lacking in many school settings (Gruenert & Whitaker, 2015). The "fragmented culture" (Gruenert & Whitaker, 2015, p. 57) in some school settings sets the stage for teachers in diverse departments and teachers who teach various subjects within a department to interact less often as a unified team to push student achievement and support student development across their different classes (Gruenert & Whitaker, 2015). Although educators can use diversity to justify sustaining fragmented efforts, heterogenous school environments are not an inherent hinderance to PLT function and synergistic efforts.

Through PLT work, education leaders can harness the energy and efforts of their multifaceted educational team to create unified operations that spark creativity and consistency in identifying areas of need, in analyzing data, and in applying resources effectively to meet the needs. In addition to facilitating their own development in understanding principles of PLT structure and function that apply to their school site, education leaders must spend time to assist in development of their leadership team, faculty, and staff to produce PLTs that develop to maturity. The transition in mindsets and working knowledge bases that supports viable PLTs must be ushered in through training and reflective learning (DuFour, 2004; Graham & Ferriter, 2010). Educational leaders can facilitate change needed to build effective, viable PLTs. Change is a process; researchers have identified principles, stages, and supports to the process (DuFour, 2004; DuFour et al., 2010; Fullan, 2001; Graham & Ferriter, 2010; Hall & Hord, 2015).

In this chapter, I discuss DuFour's (2004) three basic principles of PLTs and Senge's (2006) principles of learning organizations. I discuss stages of PLT development, the role of the administrator in supporting PLT development, and the shared leadership model. I present research on the impact of PLTs on student achievement. I discuss the importance of student achievement in science and biology. I expound on the theoretical and conceptual frameworks of the research.

Principles of Learning Organizations

Walker (as cited in Lambert et al., 2002) discussed the origin of "learning organizations" (p. 23) in the world of business to promote learning for the entire organization and not only for individual employees and supervisors (Lambert et al., 2002). This learning approach to business increases the organization's "adaptability"

(Senge, 1990, para. 5) and "generative learning" (Senge, 1990, para. 6). To embrace the approach, organizational leaders have to change their perspectives on the design for interactions, communication, responsibilities, and human capital resources within the company (Fullan, 2001; Graham & Ferriter, 2010; Lambert et al., 2002; Senge, 1990). Senge (1990) believed world systems stifle the natural tendency of individuals to explore. He insisted organizations punish individuals who make mistakes or experience failures with decreases in status or pay. The same organizations rewards individuals who are successful according to the organization's parameters with promotions in rank or paygrade. This authoritarian culture discourages employees from taking risks and from trying new ideas for fear of regressing in their status or pay in the company. The result is a culture that limits the quality of the organization and encourages the status quo (Senge, 1990). Using Senge's (2006) five disciplines, a learning organization could systematically tap into and cultivate all human resources within the company.

Senge (1990) described five foundation principles, or disciplines, for learning organizations: shared vision, personal mastery, team learning, mental models, and systems thinking (see Table 1). Senge (1990) connected the five disciplines providing avenues to affect changes within the organization (DuFour et al., 2010; Fullan, 2001; Senge, 1990; Thompson et al., 2004). The personal mastery discipline is the birthplace of learning for the organization. Individuals progress as they maintain "creative tension" (Senge, 2006, p. 132) between their situation and their goals. When team members are invested in the organization, their progress toward their personal mastery propel the organization in the shared vision discipline. Members rally around the shared vision, or common cause, and explore their creativity to accomplish the shared vision. The shared

vision acts as a point of cohesion for the members of the organization. Each advancement by the team or by individuals results in progress for the entire organization. The shared vision and personal mastery disciplines strengthen the team learning discipline. Team learning is another point of cohesion that synchronized the growth for all employees. Senge (1990) suggested organizational leaders could use team learning to strengthen the entire organization. Not only must the efforts of team members be coordinated, but their view, or mental model discipline, must be aligned for optimal advancement and adjustments to the operation of the organization. A mental model is our understanding of the world—our view of basic truths and systems. Mental models govern the way people approach problems and filter what people observe. Organizations could thrive and learn, if members are able to utilize mental models that had been analyzed and found to be sound. Organizations suffer when the team member mental models become stagnant and team members cannot adopt new models that align with the present truths. The systems thinking discipline weaves together the other four disciplines into a unit that is more effective than any one discipline in isolation. Systems thinking is the key element that can escape organizations seeking to change (Senge, 2006). In systems thinking, every faction of the organization—small and large—is deemed important. The disciplines make the learning organization coherent and focused, elevating each employee to a vital player in the organization's evolution and survival.

Table 1

Senge's (2006) Five Disciplines of Learning Organizations

Disciplines	Description of discipline
Systems thinking	System thinking values the entire system as well as the smaller interlocking parts that create the system. Systems thinking values the role of the smaller parts play in creating the entire system.
Shared vision	The shared vision is the common cause that unifies and inspires members of the team.
Personal mastery	Personal mastery is individuals constantly improving themselves and persistently reaching toward their full potential.
Mental models	Mental models are concepts people hold as truths and standards about their world.
Team learning	Team learning is a coordinated effort that harnesses the abilities of the members to reach the goal of the organization.

Note. Adapted from "The fifth discipline: The art and practice of the learning organization" by Senge, P. M. (2006). *The fifth discipline: The art and practice of the learning organization.* New York: Doubleday.

Not only does a learning organization culture motivate its members to create and explore new concepts, it also creates a system to improve the collective knowledge, to build relationships among different levels of employees, and to boost the overall cohesiveness of the company. In formal and informal settings, staff share tacit knowledge and fill in each other's deficits in understanding and in application (Fullan, 2001). Positive relationship building among different levels of employees raises the morale and gives employees emotional support (Fullan, 2001; Graham & Ferriter, 2010; Gruenert & Whitaker, 2015). The interconnected nature of learning organizations reinforces the development of the entire organization as well as the advancement of individuals. The

synergy resulting from coordinated efforts gives employees a voice in the company and ownership of the progress of the company (Fullan, 2001). Employees feel more connected to the advancement and maintenance of the company. The input and buy-in from employees reinforce a supportive work climate and a norm of teamwork. Employees who are in tune with the vision and inner workings of a company are the company's richest source of ingenuity and troubleshooting (Fullan, 2001). Our current society needs a model of "integrating thinking and acting at all levels" (Senge 1990, para. 4) of an organization—not just at the top of the organization—to increase the likelihood of the organization's longevity (Fullan, 2001; Senge, 1990). Organizations with a learning culture evolve with changing markets and experience long-term success when the organization channels the abilities and vison of its employees (Fullan, 2001; Senge, 1990). The collective knowledge adds to the uniformity of mindset, improves the consistency of production, and supports a self-renewing culture that is not present on the individual level (DuFour et al., 2010; Fullan, 2001; Senge, 1990). The application of the learning culture reaches beyond the world of business where it originated to other venues such as education.

Application of PLTs in Education

Senge (2006) applied his principles for learning organizations in business to educational institutions. Senge (2006) insisted, "students and teachers work together as learners and mentors rather than passive listeners and all-knowing experts" (p. 361) to develop "innate skills" (p. 361) of students. This model of continual improvement is a paradigm shift from the traditional "'event mentality'" (Hall & Hord, 2015, p. 5) in education where administrators expect teachers and students to master newly

implemented programs and produce drastic academic results within the first years of implementation.

Enacting the learning organization concept is not a light feat. Embracing the concept includes many changes to long-standing concepts and approaches in running an educational entity. As school districts transition to learning organizations, leadership is shared among the education professionals, and the leadership style shifts from an authoritarian style to a more democratic style. The learning organization model manifests as a PLT in the field of education. The PLT model is a timely support amidst the increase in accountability in education through governmental testing (Thompson et al., 2004). The accountability necessitates the evolution of educational practices to meet changing needs of students and society.

Developmental Stages of PLTs

The central purpose of PLTs in education is increasing student achievement through adult learning, collaboration, and reflection on school data. PLT development is unique per site to address specific needs and populations of the site, yet PLTs in general have basic qualities that make them effective (Danielson, 2006; DuFour et al., 2010; Graham & Ferriter, 2010). PLTs develop over time through identifiable stages (Drago-Severson, 2009; DuFour et al., 2010; Fullan, 2001; Graham & Ferriter, 2010; Hall & Hord, 2015). Graham and Ferriter (2010) discussed developmental stages of PLTs.

Graham and Ferriter (2010) explained the stages of PLT development and the factors that can create effective PLTs. The stages, originally described by Bruce Tuckman (as cited in Graham & Ferriter, 2010), are the

- “Forming” stage where the team members are trying to understand the

purpose and function of the PLT, and members are congenial towards each other;

- "Storming" stage where members set unachievable targets and members have power struggles over the direction of the PLT;
- "Norming" stage where team members are becoming more productive together and members have developed positive connections that they intentionally try to maintain; and,
- "Performing" stage where the team members are accomplished at PLT processes and members are interdependent, working together fluidly. (Graham & Ferriter, 2010, pp. 70-71)

PLT members could track their growth through stages and apply aids to continue the progression. The rate of the progression through these stages varies according to each PLT's unique combination of members and the attributes of its setting (Danielson, 2006; Drago-Severson, 2009; Graham & Ferriter, 2010).

Within the PLTs, members improve skills such as restructuring school procedures, communicating effectively with colleagues, reflecting on practices, and addressing needs of all students. These skills could maximize the effectiveness of PLTs when they were addressed simultaneously and linked to each other (DuFour et al., 2010; Senge, 1990). PLTs improve learning for all students **(**Danielson, 2006; DuFour et al., 2010; Graham & Ferriter, 2010) by promoting improvements in "teaching culture" (Vescio et al., 2007, p. 85) and "collaboration" (Vescio et al., 2007, p. 84).

Researchers distinguish traditional professional development for educators from PLTs by the focus and the approach in PLTs. PLTs use student data to identify areas of

needs, to promote collaboration, and to create solutions to address student needs. The "process of discussion" (Danielson, 2006, p. 134) fosters "common understanding" (Danielson, 2006, p. 134) in the learning team. Within PLTs, educators are learners and teachers (Fullan, 2001; Senge, 1990, 2006; Vescio et al., 2007). The practice of ongoing teacher learning is a key factor in PLTs and must be infused into the culture of the institution to maintain the support of PLTs. Knowledge sharing among educators and professional development that accompanies the change to a learning community focuses on using data that show student learning instead of focusing on building a teacher's toolbox of strategies (Blankenstein et al., 2010; DuFour et al., 2010; Graham & Ferriter, 2010; Vescio et al., 2007). In PLTs, educators could use data to identify the root of student difficulties in learning and identify ways to address the difficulties through collaboration and reflective practices (Vescio et al., 2007). PLT study data tend to help them personalize the learning experience for students and target areas of need. School leaders have a role in promoting PLT functioning.

Shared Leadership

Administrators have an arduous task of bearing the weight of accountability within an educational system. The federal and state governments add to the pressure on administrators as they adopt new governmental acts and entertain policies linking student achievement to pay scales. Through PLTs, administrators can share leadership with and spread responsibility among staff members to offset the pressure. The administrators put responsibility and leadership in the hands of the people who work daily with students and who see firsthand the need and impact of strategies and repurposing of resources. Principals must willingly share the workload and trust their employees to make the right

decisions for students (Danielson, 2006; Drago-Severson, 2009; Vescio et al., 2007). School administrators empower teachers to make needed changes, to hold each other accountable to participate in the decision-making, to enact the group's decisions, and to report the data on the effectiveness of the decisions. Small learning teams of classroom teachers and educational specialists can adjust more quickly and accurately for the specific students they serve, because they are in close contact with the students to analyze formal and informal assessments. As administrators yield authority to PLTs and as PLTs develop, teacher leaders emerge, strengthening the internal structure of the institution. The school develops from within, tapping into resources of the PLT members and forming mutualistic relationships among members (Fullan, 2001; Graham & Ferriter, 2010; Vescio et al., 2007). Administrators can be intentional in setting the stage for PLT growth (Graham & Ferriter, 2010)

Administrators have a responsibility to create an atmosphere for PLT development so teachers have the most effective PLTs. Administrators can access resources like outside trainers to help educators understand PLT development. Administrators' intentional provision of support and direction smooths the transition to a PLT culture of transparency, group accountability, constant monitoring of data, and frequent adjustments to instruction. Administrators who are not diligent to give authority to PLTs may do so because of changes in testing results.

Administrators can be unwilling to share leadership with teachers for fear of implementation dips (Fullan, 2001) that may occur as PLTs develop. Implementation dips are "dips in performance and confidence as one encounters an innovation that requires new skills and new understandings" (Fullan, 2001, p. 40). Administrators who

are under pressure to increase test proficiency percentages may resort to traditional means of boosting test scores without teacher feedback in PLTs to avoid negative changes in test performances. Researchers study changes in student performance that can occur because of work in PLTs.

Research on the Impact of PLTs on Student Performance

Roberts (2010) conducted a mixed method study of the effect of PLT functions on student achievement in math and English or language arts in elementary, middle, and high schools. Roberts used DuFour's (2004) three big ideas on "core principles" (p. 6) in PLTs as the framework for the study. Dufour's first big idea is "Ensuring that students learn" (p. 6); the second big idea is "A culture of collaboration" (p. 6); and the third big idea is "Focusing on results" (p. 6). In Roberts's study, teachers graded skill levels related to these ideas using a survey. Roberts used a pilot study and the data from the pilot study to ensure the survey was valid and reliable. Roberts compared the results of the surveys to student achievement on criterion-referenced test scores "linked to individual teacher surveys responses" (p. 7). In Roberts's study, the teachers graded their "personal skill level in assuring that all students learn at high levels" (p. 7) , graded their PLT's "skill level in creating a culture of collaboration" (p. 7), and graded their PLT's skill level in "focusing on academic results" (p. 7).

The skill levels teachers rated the highest in personal skills to assure students learn were knowledge of critical elements students need from the content, preparedness to accommodate students who need extra support, and utilizing customized strategies that increase learners' duration with the material to guarantee proficiency (Roberts, 2010). Roberts's (2010) results are consistent with DuFour's (2004) first big idea of "Ensuring

students learn" (p. 6). DuFour identifies the first big idea as the central idea and impetus for school improvement. Educators must clarify, track, and respond to each learner's progress in the content area.

The skill levels teachers rated the highest in their PLT creating a culture of collaboration were "collectively deciding upon essential outcomes linked to state/district standards" (Roberts, 2010, p. 122), "creating common formative assessments, creating common summative assessments" (Roberts, 2010, p. 122), and "examining results from common assessments" (Roberts, 2010, p. 122). DuFour (2004) deemed the collaborative culture as the second big idea that supports effective PLT functions. The idea involves forming relationships and creating protocols to unify efforts to increase efficiency (DuFour, 2004; Fullan, 2001; Graham & Ferriter, 2010).

The skill levels teachers rated the highest in their PLT focusing on academic results were "honestly confronting the brutal facts regarding our student's achievement data" (Roberts, 2010, p. 124) and "determine the student's current level of achievement" (Roberts, 2010, p. 124). These results align with DuFour's (2004) third big idea involving use of data as a tool to identify and monitor learning. DuFour challenged PLTs to be intentional in identifying relevant data sources and to be consistent in using data.

Roberts (2010) discussed PLT activity and student achievement. Roberts identified a positive correlation between teacher perceptions of PLTs and student achievement in both math and reading for elementary and secondary schools. Roberts did not find correlations between teacher perceptions and achievement scores that were statistically significant. Roberts linked consistent achievement scores to PLT activities and concluded the activities within the PLTs developed teacher skillsets and dedication.

Also, Roberts found a strong, collaborative environment in the participating school with success in supporting student achievement. Roberts interpreted the "stability in student achievement" (p. 126) as consistency in teacher performance and fidelity in teacher effectiveness developed and reinforced by PLTs.

Reynolds (2008) investigated PLT effects in a middle school. Reynolds conducted a qualitative case study using teacher observations, teacher interviews, and archived data from the California's Academic Performance Index and Adequate Yearly Progress reports. Reynolds measured teacher perceptions of traits in successful PLTs, positive effects of PLTs, and data as a tool for improvements. In the research study, participants recounted PLT development that occurred over time and the skills PLT members honed. Participants agreed the shared vision, "collective sharing and [data-driven] decision making" (Reynolds, 2008, p. 72), and PLT norms were factors that made their PLTs effective. Participants were proud of the progress of the PLT as well as the consistently high achievement scores and academic growth of students. Participants attributed the presence and success of PLTs to the leadership and modeling of their principal.

Kincannon (2010) conducted a causal-comparative quantitative study in a high school. Kincannon considered the graduation rates and science achievement between high schools that had official PLTs and those that did not. Kincannon surveyed educators who worked at different levels of the school system. Kincannon used archived data from Texas Essential Knowledge and Skills science scores for sophomores and juniors and from high school completion rates. Kincannon found PLT "concepts and practices" (p. 169) were used at both school sites. The school site official PLTs outscored the non-PLT school site in proficiency of implementing techniques to address struggling learners,

"building a collaborative culture" (Kincannon, 2010, p. 168), using data to drive instruction, "focusing on learning" (Kincannon, 2010, p. 168), and establishing a "mission" (Kincannon, 2010, p. 168) for the school. Kincannon concluded that PLTs "positively affect science student achievement" (p. 173) and graduation rates. As with Kincannon's work, research in science is important for future advancement.

Need for the Research Study

The research study fulfills a need for more data and analysis of the association between perceptions of PLT skill levels and science achievement. Science is an important field on local, national, and global levels. Science is a central part of 21st century competency and STEM education, a pathway to economic growth, and a support to other disciplines.

The Importance of Science

Science is a core subject in 21st century and STEM education. Education organizations, industries, and other stakeholders collaborate to form partnerships that define and support 21st century learning. The ultimate goal is to ensure today's students are equipped to enter the workforce, do research, address current and future problems, and develop innovative ideas. Without a constant supply of prepared high school graduates, higher education and businesses suffer shortages in qualified applicants and are unable to meet changing global demands. We live in a "society affected so importantly by science and technology" (National Research Council Committee on High-School Biology Education, 1989, para. 2) that neglect in scaffolding science learning and lack of attentiveness to ways to improve learning in science would be detrimental to the future of the country and the world. As educators work to make 21st century initiatives

and STEM training a norm in every school on every level, they set a platform to boost the capacity of the workforce to break barriers in addressing complex world issues (National Science & Technology Council [NSTC], 2018). Leaders confirm the "need [for] a firm grounding in mathematics, science, and technology" (National Science Board Commission on Precollege Education in Mathematics, Science, and Technology, 1983, para. 5) for our graduates to meet everchanging demands in our world. Global educators and leaders work together to establish and maintain pipelines to produce a continuous supply of STEM-educated students and prepare students for jobs that do not yet exist. Within the 21st century learning and STEM education context, science is a vehicle for change that is fueled by our focus on factors that affect science education learning. Science and the intertwining of its topics empower the world to envision new ways to approach understanding our world (Naisbitt, 2006). Not only is science important to securing future demands, it also undergirds economic growth.

Increases in science learning have an impact on local, state, and national levels. Science is one of the "key determinants of economic growth, and economic growth is the key to national power and influence as well as individual well-being" (Friedman & Mandelbaum, 2011, p. 100). "The success of the nation" (National Council of Supervisors of Mathematics [NCSM] & National Council of Teachers of Mathematics [NCTM], 2018, p. 1) is linked to "how well we address science, technology, engineering, and mathematics in our k-12 education" (NCSM & NCTM, 2018, p. 1).

Currently, the United States falls behind other countries in science literacy scores in k-12 education (NSTC, 2018; National Science Board, 2018). The lack in science knowledge in K-12 education translates to decreased completion of postsecondary

education and to more time invested in preparing incoming college students (National Science Board, 2018). This scenario exacerbates the struggle for the United States to be competitive in global markets. Decline in the ability to compete puts a strain on economics of the country, causing a domino effect on state and local economies. Struggles in science education affect the nation as whole and affect each citizen.

On an individual level, science education and science literacy help equip citizens to make "informed choices for themselves, their families, and their communities" (NCSM & NCTM, 2018, p. 1) in a world where their grasp of concepts and topics must exceed the norms of the past (NCSM & NCTM, 2018). Creating an avenue to ensure consistent success in science topics and the other core STEM subjects for each citizen "is vital to preparing a diverse workforce needed for the United States to lead and prosper in an increasingly competitive world driven by advanced technology" (NSTC, 2018, p. 1). Preparedness created by ensuring sound science education supports personal exploration into entrepreneurship and higher paying jobs that support economies on all levels. Citizens who can support themselves and their family are less likely to need government agencies for help with basic necessities of life, providing a greater pool of funds available to address gaps in education. Science education supports growth in economics and supports the framework of other disciplines.

Underlying principles and skills in science carry over to other STEM and 21st century disciplines. Problem-solving and higher order thinking skills developed in science learning support learning in the other STEM disciplines and in 21st century learning. Science as a 21st century subject contains interdisciplinary themes such as global awareness and environmental literacy that are also embedded in the other core

subjects. This connection with other core topics makes science learning an avenue to better understanding other core topics. Science as it supports learning in other STEM topics supports efforts of state and federal governments to equip its citizens for the future, decrease the economic gaps between subgroups, and bring an overall stable economy. Science as a whole is important to preparing citizens. Within the field of science, biology is a necessary course.

The Importance of Biology

Biology is a required life science that includes topics such as genetics, ecology, cell biology, and evolution. It is usually taken within the first 2 years of high school. Biology is important because it extends learning of life science topics from primary grades and it continues to develop scientific thinking to support success in advanced courses.

A biology course sets the stage for students to understand the interconnectedness of science topics, as it is the culmination of life science topics learned in Grades K-8. Students who learned parts of different life science topics in Grades K-8 now explore all the topics within one class. Within the course, students delve deeper into the topics while learning the connections, cause-and-effect relationships, roles among life science topics, and effect of human activities. This 21st century approach of weaving topics together supports a greater foundation in all life science topics and deepens the understanding of humans' role in preserving life on Earth.

Studies in biology build foundational knowledge on different levels of organization of living things, on factors that affect each level, and on processes that sustain life. The topics spur students to research, monitor, develop, and address biological

issues and preventative measures. People from different disciplines who have grasped core biological principles can work together to create solutions to complex world problems. As students learn connections among topics, they practice and extend the principles of scientific thinking to increase their understanding.

The value of analytical thinking developed in biology is immeasurable as it supports learning in advanced courses. In biology, as students build skills in problem-solving with the scientific method, they build a foundation that helps them be successful in advanced courses (National Research Council [NRC], 2014). Its place as a foundational core course and extension of primary learning makes biology a course that must be supported to ensure students are increasingly successful. More research is needed to understand how to improve student achievement in biology.

Gaps in Research

More research on the effect of biology teacher actions on student achievement can improve understanding and quality of biology education. Information on teacher effects on student achievement can inform policy maker decisions and provide insight on needs for change in the structure of education (NRC, 1985). Education departments and national organizations align initiatives and assessments to better understand teacher effects and student learning in science (NRC, 2014). These organizations recognize that teaching actions and student outcomes must be studied in specific science subjects (NRC, 2014) to understand the intricate relationships and to impact learning. There is a gap in research on biology PLTs and their specific impact on student achievement.

Researchers have studied the association between PLT and science topics but not in the manner I studied the topic. Sims (2013) conducted a qualitative case study on PLT

perception of secondary science teachers, but biology teachers were not among participants. Sims gathered qualitative data but did not link the data to student achievement data. Sims polled teachers on changes in practices including using time and lesson planning, but Sims did not specify foundational PLT factors as found in DuFour's (2004) writings. Browne (2014) researched the relationship between PLTs and science curriculum.

Browne (2014) conducted a case study. Browne used a survey to gather data on perceptions of the science PLT's role in the planned changes in science curriculum. The data showed that the PLT did influence the change (Browne, 2014). The work in Browne was different from my study by the focus and the population. Browne tested science PLTs in middle schools in Arizona, but I tested biology PLTs in high schools in North Carolina. Johnston-Estes (2009) surveyed principals on the influence of PLTs on student achievement.

Johnston-Estes (2009) conducted a mixed method study linking principal perceptions of PLTs and student achievement in high schools. Science was one of the subjects included in the study, but the scaled scores were combined with scaled scores from other subjects (Johnston-Estes, 2009). I focused only on biology student achievement. Johnston-Estes surveyed participants on similar PLT topics such a collaboration and "focus on continuous improvement through the use of data to plan instruction and assure all students learn" (p. 33). I did not include "common belief system" and "sustainability" (Johnston-Estes, 2009, p. 33) topics that Johnston-Estes included in the study. The research study also differed from the research of Johnston-Estes by location and instrumentation. Though researchers have studied associations

between science achievement and PLT perceptions, the research study filled a specific niche to understand the association between biology teacher perceptions of PLT skills and student achievement. The research study was needed to fill the gap in information.

In this research study, teachers recorded perceptions of actions within biology PLTs to focus on and promote academic achievement in biology. I evaluated the associations between the teacher perceptions of collective teacher actions and reported student achievement data in the form of GLP percentages. I reported the GLP percentages in ranges—low GLP range (<5-33%), medium GLP range (45-65%), and high GLP range (80->95%). The GLP percentage for the state is 60.1% (NCDPI, 2019, p. 4). As I conducted a research study to test the effect of PLT work on student achievement in the target population, I conducted the research using specific theoretical and conceptual frameworks.

Theoretical Framework

Postpositivism is the theoretical framework for this research study. Postpositivist worldview presupposes that researchers can collect information that could enhance and clarify the knowledge base on the specific topic (Creswell, 2014; Fischer, 1998). Researchers use gathered information and logical thoughts to uncover underlying principles and cause-effect relationships. Researchers use methods to limit the influence of their personal views on the information and consider the results valid if other researchers can replicate the study and come to similar conclusions. Even though researchers limit their biases on the results, conclusions are still subject to the perspective of the observer and the audience (Fischer, 1998). Researchers discuss the results of the study and try to explain discrepancies between previous results and current results, if any

discrepancies exist. The postpositivist worldview rejects the idea of static truths; therefore, the accepted truths extracted from the conclusions change as underlying principles and relationships are realized through analysis of test results (Creswell, 2014; Fischer, 1998).

Conceptual Framework

Dufour's (2004) concept of three big ideas of PLTs is the conceptual framework of the research study. Dufour's first big idea is "ensuring that students learn" (p. 6); his second big idea is "a culture of collaboration" (p. 8); and his third big idea is "focusing on results" (p. 10). DuFour explained foundational elements of PLCs and provided guidance to initiating and sustaining PLT development. DuFour gave the reader clarity in the process of leading a team into effective PLT functions (Danielson, 2006; DuFour & DuFour, 2012; Graham & Ferriter, 2010). Foundational factors of effective PLTs also spark other transforming factors such as change among different factions of the organization; a culture of mutual respect, confidence, and interdependency among PLT members; and acceptance and use of conflict as a mode for positive changes (Graham & Ferriter, 2010). Other transforming factors are data analysis used as a continuous tool to determine the current state of the topics addressed and intentional increase in shared knowledge to keep the decisions and responses of the PLT relevant (Graham & Ferriter, 2010). PLTs mature through levels that are identifiable by changes in the interaction among members and in the focus of the team (Danielson, 2006; Drago-Severson, 2009; DuFour & DuFour, 2012; Graham & Ferriter, 2010).

DuFour's (2004) first big idea is "Ensuring that students learn" (p. 6). DuFour discussed the need for educators to take a comprehensive look at student achievement at

their school site. DuFour challenged educators to “become aware of the incongruity between their commitment to ensure learning for all students and their lack of a coordinated strategy to respond when some students do not learn” (p. 7). DuFour said the strategies should be “systematic and schoolwide” (p. 7) strategies that are “timely” (p. 7), “based on intervention rather than remediation” (p. 7), and “directives” (p. 7) to students rather than optional support. DuFour gave a real-world example of an “intervention program” (p. 7) at a high school.

In the intervention program described by DuFour (2004), students received support from a variety of school personnel and peers. The school personnel monitored progress and involved the parents. The intervention program featured increasing levels of support if learning did not improve. In their PLT, all members of the PLT worked together to find root causes and brainstorm on ways to address each cause. Various stakeholders—educators, students, parents, and community partners—were informed of progress and were held responsible to provide support to help struggling students.

DuFour (2004) deemed collaborative culture as the second big idea that supports effective PLT functions. The idea involves forming relationships and creating protocols to unify efforts and increase efficiency (DuFour, 2004; Fullan, 2001; Graham & Ferriter, 2010). PLT members work together to resolve differences in personality and ideology through a determination to support all students (DuFour, 2004; Fullan, 2001; Graham & Ferriter, 2010). The result is a mutual respect for the contributions of each PLT member and a sharpened focus on the needs of students. DuFour explained the efforts of a third-grade team who collaborated to improve the learning of their students.

DuFour (2004) described the third-grade teachers studying topics together. They

studied the curriculum, standards, skills needed for fourth grade, and strengths and weaknesses on common assessments. They shared and discussed their results, challenges, and answers. The "collaborative conversations call on team members to make public what has traditionally been private—goals, strategies, materials, pacing, questions, concerns, and results"(DuFour, 2004, p. 9). The third-grade team "removed barriers to success" (DuFour, 2004, p. 6) by contributing and receiving information to move towards the common goal on behalf of their students.

DuFour's (2004) third big idea is "a focus on results" (p. 10). According to DuFour, "the results-oriented professional learning community not only welcomes data but also turns data into useful and relevant information for staff" (p. 10). Educators use data to identify areas of need and track learning. DuFour challenged educators to be intentional in identifying relevant data sources and to be consistent in using data. PLTs who cultivate a collaborative culture of sharing responsibility and sharing resources take advantage of skills and resources available through each PLT member. To show a real-world example of focusing on results, DuFour highlighted an intermediate school staff who systematically accessed data and tracked student results.

PLTs in the intermediate school described by DuFour had well-developed PLT functioning, so they were able to be transparent with team and personal data (DuFour, 2004; Graham & Ferriter, 2010). PLTs faced learning deficits and inconsistent growth head-on, creating strategies and leveraging collective resources to address weaknesses. The work of the PLTs centered around the improvement of student learning and the development of educator skills.

The application of DuFour's (2004) three big ideas in the three schools improved

student achievement by increasing the effectiveness of the PLT. The same increase in effective PLT function and improvement in student achievement could be true for biology teachers and students respectively. In this research study, I collected data on biology educator perceptions of their skill and their PLT's skills in adhering to DuFour's three big ideas. I compared the means of teacher responses and looked for connections between the perceptions and biology student achievement.

Summary

In this chapter, I discussed concepts on PLT function. I explained the origin of PLTs within the business sector, the learning team concept, the function of PLTs within the field of education, developmental stages of PLTs, input of administrators on PLT functioning, and research on the links between PLTs and student achievement. PLTs provide avenues to focus work around student need. Creating effective PLTs is a process that can be influenced by educators on different levels.

I discussed the importance of science learning and biology. Science is a subject in 21st century learning and STEM education, and it is an avenue to develop analytical thinking skills. Science is of national importance because it is one of the key topics that helps the United States remain relevant in developing new technologies. The specific science course of biology trains students to apply analytical thinking and integrate topics to get deeper understanding of relationships. This training carries over into other disciplines and acts as a scaffold to support learning in different contexts.

I discussed gaps in research and the need for further study. I explained research studies that tested links between PLT function and student achievement but not specifically focused on DuFour's (2004)three big ideas and/or biology education. Sims

(2013) gathered qualitative data in science but did not have participants who were biology teachers.

I explained the theoretical and conceptual frameworks: postpositivism and DuFour's (2004) three big ideas respectively. The postpositivist approach is an evidence-based approach that seeks to verify causal relationships among identified factors. Postpositivism assumes relationships can be understood through testing and data analysis. DuFour's three big ideas of PLTs are (a) ensuring that students learn, (b) a culture of collaboration, and (c) focusing on results. DuFour considered the learning team concept a tool to address weaknesses in student achievement and used the three big ideas as foundational features.

In Chapter 3, I discuss the methodology of the study. I explain the procedures for the study including the recruitment of the target population and data collection. I show the alignment of survey items with research questions and discuss methods of analyzing data. I show the alignment as an extension of Roberts's (2010) research study.

Chapter 3: Methodology

Introduction

Educators form PLTs to address academic needs of students (Danielson, 2006; DuFour et al., 2010; Graham & Ferriter, 2010). According to DuFour (2004) successful PLTs "focus on learning rather than teaching, work collaboratively, and hold [themselves] accountable for results" (p. 6). DuFour called these three foundational concepts the three "big ideas" (p. 6) of PLTs. In focusing on learning, PLT members use data as indicators of the needs of students and student subgroups. The strength of PLTs is the collaborative work—the team effort and actions to address student needs. PLT members learn to look beyond the students in their classroom to be active in serving the students of all the PLT members (Danielson, 2006; DuFour et al., 2010; Graham & Ferriter, 2010). PLT members pool data from each classroom and create data sources to identify trends. This focus on results, or data, gives PLTs indicators to drive their decisions, plans, and actions (Blankenstein et al., 2010; DuFour & DuFour, 2012; Graham & Ferriter, 2010). PLTs track the progress of students and student groups creating resources to address deficiencies in learning. In this research study, I explored associations between PLT work and student achievement in biology. I collected biology teacher perceptions of PLT skill with the three big ideas (DuFour, 2004) using an online survey and looked for connections with GLP percentages from state biology student achievement data. I reported GLP percentages by ranges—low GLP range (<5-33%), medium GLP range (45-65%), and high GLP range (80->95%). The GLP percentage for the state is 60.1%.

I used a mixed-methods approach to evaluate associations between participation

in PLTs and student achievement in biology courses. The research study was a replication by extension of Roberts's (2010) research study. The university Institutional Review Board approved the research study (Appendix A). I used a convergent, mixed methods design in which I collected quantitative data and qualitative data simultaneously, analyzed the data separately, and then merged the results of the analyses (Creswell, 2014). Mixed methods research serves to glean the benefits of both types of data (Creswell, 2014). A benefit of quantitative data is that it can be "analyzed with statistical methods" (Butin, 2010, p. 77) to show the presence or absence of statistical significance. A benefit of qualitative data is that it comes directly from participant perspectives giving "attention to nuance and detail" (Butin, 2010, p. 77) and can "take into consideration opinions and perspectives that may not initially be visible or obvious" (Butin, 2010, p. 77) to the researcher. Using a combination of quantitative and qualitative data increased the depth of the study in that it invited participants to weigh in on the research questions while expressing their views in their own voices. I collected qualitative data to fill gaps in understanding of quantitative data (Creswell, 2014). I used an online survey distributed through the CR district email system to collect perceptual data of biology PLT functioning and gathered CR district data for student achievement from the NCDPI accountability services webpage. In the survey, teachers rated themselves and their PLT's skill in adhering to DuFour's (2004) three big ideas. This research study can serve as a source of data for educators on all educational levels who impact PLTs.

The findings from this research study can potentially be useful to help district leaders, school leaders, and faculty in supporting the development of biology PLTs and improving biology achievement. NCDPI uses biology GLP percentages from state

summative tests in the formula to grade the state, districts, and schools on North Carolina report cards. By targeting biology PLTs and biology GLP percentages, district and school educators can increase student learning and teacher effectiveness and positively affect North Carolina report card scores. The research study can raise biology PLT member awareness of various PLT characteristics at work and raise awareness of their own perspective PLT effectiveness. The research data can be used in conjunction with other district and school data to identify and track needs of biology teachers and students. The components of this extension research study were tailored for the specific target population and target setting,

In Chapter 3, I explain the components of the research study including the setting, research design and rationale, and methodology. For the setting, I discuss the physical location of the study, people who may influence the results of the study, and aspects and pressures of the biology subject that warrant a research study. The setting influences the research design and rationale of the study.

I replicated Roberts's (2010) nonexperimental research design by extension, meaning I duplicated Roberts's research study and adapted components to the target population. I discuss the design features and rationale of the research study such as the research questions, reasons for a mixed methods design, theoretical framework, and conceptual framework. I continue with a discussion of the methodology of the study.

The methodology of the study includes instrumentation, procedures, data collection and analysis, and participant qualifications. I deconstruct the fine points of quantitative and qualitative instruments used, recruitment of participants, statistics used to understand the quantitative data, and themes used to understand the qualitative data. I

close the chapter with a summary of Chapter 3 and an introduction to Chapter 4.

Research Design and Rationale

The research study is a convergent, mixed methods study. I triangulated perceptual quantitative and qualitative data with biology GLP percentages to identify possible associations among variables. I analyzed data to determine associations between data gathered around each of DuFour's (2004) three big ideas and student achievement. In the survey, I collected quantitative and qualitative data concurrently, analyzed the types of data separately, then merged the results (Creswell, 2014). I collected data concurrently so participants could immediately give qualitative feedback for their quantitative responses. I used the qualitative data to inform quantitative data results (QUAN, QUAL; Creswell, 2014). Mixed methods studies take advantage of both data types filling in gaps of understanding for each data type. Qualitative data provide information in the participant's voice that could explain or challenge quantitative perceptual answers. The sources of quantitative data for this research study are Likert scale questions on the perceptual teacher survey and public student achievement data reported by the range of the GLP percentage. The sources of qualitative data are open questions on the perceptual teacher survey. I used data from the study to explore connections between student achievement and perceived PLT skills.

The purpose of the study is to understand the connections among perceptions of PLTs functioning with DuFour's (2004) three big ideas and student achievement on a school level. I focused on biology teacher perceptions and reported student achievement on the state summative biology test. I used an anonymous, online survey to gather teacher perceptual data using Likert scale questions and open-ended questions. I collected

biology state test GLP percentage levels from the NCDPI accountability services website and reported percentage levels by range. I used a version of Roberts's (2010) central question for the research study.

Research Questions

This research study was an extension of Roberts's (2010) research on PLTs. I used a version of Roberts's central research question for this replication study. My central research question was, "How has student achievement been impacted when educators worked in PLTs?" The supporting research questions were

1. How do biology teachers perceive their personal skill level in assuring that all students learn at high levels?
2. How do biology teachers perceive their PLT's skill level in creating a culture of collaboration?
3. How do biology teachers perceive their PLT's skill level in focusing on academic results?
4. To what extent do biology teachers believe their teaching practices have been impacted as a result of working in PLTs?
5. What is the association between teacher perceptions of PLTs and student achievement in biology?

I used an online teacher survey housed in SurveyMonkey.com to collect perceptual quantitative and qualitative data concurrently from biology teachers. I used quantitative student achievement data in the form of GLP percentages from the NCDPI accountability services webpage. I used GLP percentages from the 2018-2019 school year. In reporting the GLP percentages, I divided the schools into three groups by percentage range—low

GLP range (<5-33%), medium GLP range (45-65%), and high GLP range (80->95%). The GLP percentage for the state is 60.1%. Each range represents a third of the schools. I grouped the GLP percentages of the schools to protect the anonymity of the participants. The quantitative and qualitative data sources informed the central and supporting research questions.

Supporting Questions 1-3 were replicas of Roberts's (2010) supporting questions with the words "biology teachers" and "team" substituted for the words "educators" and "communities" respectively. I replaced Roberts's supporting question on SMART goals with a direct question (Supporting Question 4) about teacher perceptions of the level and type of impact of work in PLTs on their teaching practices. I replaced Roberts's Supporting Question 5, which referred to changed perceptions over time, because I collected data for 1 school year (2018-2019). I reworded Roberts's Supporting Question 6 by changing the term "communities" to "teams," changing the word "educators" to "teachers," and adding the phrase "in biology" to the end of the question. I used perceptual data from teacher surveys and test data from GLP percentages reported in ranges for state summative biology tests to inform the research questions. Table 2 shows a summary of the research design and procedures for data collection and usage. I discuss the contents of the table in greater detail in the following sections. Within the research study, I used postpositivism as the theoretical framework.

Table 2

Alignment of Research Questions with the Instrument, Data Collected, and Analysis Method

Data collected	Question type	Type of data
Research Question 1. How do biology teachers perceive their personal skill level in assuring that all students learn at high levels?		
Survey Item 9	Likert scale answers	Total Likert mean per item; Likert mean per statement (for participants and schools); Percentage of responses in a level of *agree* (*somewhat agree, agree, or strongly agree*); standard deviation; one-way ANOVA
Survey Items 10-11	Open responses	Theme coding
Research Question 2. How do biology teachers perceive their PLT's skill level in creating a culture of collaboration?		
Survey Item 12	Likert scale answer	Total Likert mean per item; Likert mean per statement (for participants and schools); Percentage of responses in a level of *agree*; standard deviation; one-way ANOVA
Survey Items 13-14	Open responses	Theme coding; Percentage of participants
Research Question 3. How do biology teachers perceive their PLT's skill level in focusing on results?		
Survey Item 15	Likert scale answers	Total Likert mean per item; Likert mean per statement (for participants and schools); Percentage of responses in a level of *agree*; standard deviation; one-way ANOVA
Survey Items 16-17	Open responses	Theme coding; Percentage of participants
Research Question 4. To what extent do biology teachers believe their teaching practices have been impacted as a result of working in PLTs?		
Survey Item 18, 19	Likert scale answers	Total Likert mean per item (for rating & types of impact); Percentage of participants; one-way ANOVA

(continued)

Data collected	Question type	Type of data
Survey Item 20	Open responses	Theme coding; Percentage of participants
Research Question 5. What is the association between teacher perceptions of PLTs and student achievement in biology?		
Survey statements showing statistical significance	Likert scale answers	Fisher's Exact test; GLP percentages per school reported by ranges; Total Likert response mean per GLP range; Total Likert response range per GLP range

Theoretical Framework

This research study is a convergent, mixed methods study using postpositivism as the theoretical framework. A postpositivistic view assumes factors in our world are linked by cause-effect relationships that researchers can identify through questioning and data analysis. Postpositivism treats reality as a factor that is influenced by the individual's standpoint, culture, and experiences such that reality can evolve with the changes in the individual's perspective (Butin, 2010, Creswell, 2014). For a research study with a postpositivistic view, researchers use scientific methods to gather information (Butin, 2010; Creswell, 2014). Research results support or disprove previously accepted cause-effect relationships (Creswell, 2014; Fischer, 1998). The conceptual framework utilized DuFour's (2004) three big ideas.

Conceptual Framework

Like Roberts (2010), I used DuFour's (2004) three big ideas about PLTs as the conceptual framework. DuFour's three big ideas for PLTs are "helping all students achieve at a high level" (p. 6), "promoting a culture of collaboration" (p. 8), and "focusing on results" (p. 8). These foundational ideas allow PLTs to improve and be consistent at serving all students (DuFour & DuFour, 2012; DuFour et al., 2010; Graham & Ferriter, 2010).

Participants

Participants in the research study were teachers who taught at least one section of high school biology in the CR school district during the 2018-2019 school year. Approximately, 45 teachers taught biology in the 2018-2019 school year. Sixteen teachers participated in the research study, which was a response rate of 35%. After the required demographic and PLT structure Items 4-8, 14 of the 16 participants answered Items 9-20 which gave a response rate of 31%. Participants could opt out of answering Items 9-20. The response rates are above the average response rate of 25% (Fluid Surveys Team, 2014; Millar & Dillman, 2011) and are comparable to Roberts's (2010) response rate of 36% of the population who participated and 26% who completed the survey (p. 49).

The participating teachers completed an online survey housed in SurveyMonkey.com. The director of the science program at the district office level distributed the online survey via the CR district email system to all biology teachers. When participants clicked the link embedded in the email, they were transferred to the SurveyMonkey website to complete the survey. The week after the director sent the original email, I resent the survey invitations and reminder mass emails. Within the reminder emails, I thanked participants who completed the study and asked other biology teachers to complete the survey. During the third week, I closed the survey. Participants could exit the survey at any time. The survey included Likert scale questions and open-response questions. On the Likert scales, participants rated themselves on DuFour's (2004) first big idea of ensuring all students learn at high levels and rated their PLT on DuFour's second and third big idea of creating a collaborative culture and focusing on

results respectively. On open-ended questions, participants named strengths and needs on the named big idea as well as explained their view of the impact of PLTs on their teaching practices. I compared data from the survey to data taken from the NCDPI website to look for connections between teacher perceptions and GLP percentages reported by ranges.

Biology students take a state summative test when they complete the biology course. NCDPI reports the GLP percentage per school. I used public student data from this state summative test and reported the data in ranges, namely low GLP range (<5-33%), medium GLP range (45-65%), and high GLP range (80->95%). The GLP percentage for the state is 60.1%. I gathered GLP percentages from the accountability services webpage of the NCDPI website. I accessed the accountability services webpage of the NCDPI website and downloaded school level summary data result reports for the 2018-2019 school year. I found each participating school in the CR district on the summary data result reports and collected the data for the biology GLP percentages. I grouped the schools by GLP percentage ranges to protect the anonymity of the participants. The school level summary data result reports are public data sources.

Setting

The setting of the research study, the CR school district in North Carolina, employs PLTs to affect student learning. District leaders, staff, and faculty have created opportunities and provided training for PTL development for over 10 years. As educators meet expectations of PLT development, educator practices change to support specific identified student needs. Improvements in biology PLTs are a part of the strategy of CR district leaders to meet district goals to improve student scores and close achievement

gaps among student subgroups for all subject areas. Personnel throughout the CR district affect PLT functions and the work PLTs accomplish.

Members of the CR school district who impacted this study include administrators on all levels, PLT facilitators, trainers, PLT department personnel at the district office, and cooperating school staff. They impacted the study because they help define and shape best practices and usage of biology PLTs in the CR district. The decisions about the parameters of the functioning of biology PLTs in the district determined the extent to which PLTs could be tailored to each school. The developmental path of PLTs in schools is influenced by the atmosphere and the models exhibited by school leaders (Danielson, 2006; Fullan, 2001; Graham & Ferriter, 2010). As district and school leaders model the work ethic, responsibility, and mutual respect they expected in PLTs across the CR district, leaders set a standard for the PLT culture in the district. Leaders support positive buy-in from employees by actively seeking positive relationships with employees (Fullan, 2001; Graham & Ferriter, 2010). According to Graham and Ferriter (2010) PLT development should "progress from a focus on teaching…to a focus on learning" (p. 72) as the members shift to "collective exploration of effective instruction" (p. 73). As with all CR district PLTs, district leaders expect members of biology PLTs to operate in continuous work to identify and actively address student and teacher needs. They require biology PLTs to consider the needs of all student subgroups. District leaders expect biology PLTs to align their efforts with biology standards, to collaborate effectively, to focus on results, and to ensure all students are progressing. In line with NCDPI's efforts, the CR school district mandates PLTs meet weekly to discuss student data and to align instruction to state biology standards. NCDPI promotes the use of PLTs in public school

districts to enhance the effectiveness of educators in increasing student learning (McREL International, 2009), especially on state biology tests.

NCDPI requires all students who took a high school biology course to take a summative state test at the end of the semester. NCDPI reports biology state summative GLP percentages for each district and school and uses the GLP percentages in the formula for grading school districts and schools. The GLP percentage shows the percentage of students who score at or above baseline proficiency. I reported the GLP percentage by ranges. The scores provide a source of data to evaluate science learning in the district and to identify areas of strength and need. The state and district focus on biology is part of the national push for science learning that dates back to the 1980s (National Research Council Committee on High-School Biology Education, 1989; National Science Board, 1983).

Science is a core subject in 21st century learning and in STEM education. Science learning impacts the country's ability to compete in a global market and to stay on the cutting edge of technology development. Biology is a foundational science in secondary education for continued development in analytical thinking and integrating ideas. Principles and topics learned in biology support success in advanced courses in science and in other disciplines. Organizations and government agencies on local, state, and national levels make efforts to remain a relevant and viable force in a global economy. The understanding of how to better support biology learning through PLTs is an avenue to support the efforts. This research study explored the links between biology learning and perceived PLT functioning using a mixed methods design.

Role of the Researcher

I was an internal and external evaluator in this research study. I was an internal evaluator because I am employed in the CR district and have taught biology courses. I was an external evaluator because I did not participate in the survey for biology teachers. I overcame possible biases by using an online anonymous survey for the research study, using independent researchers to validate themes, and using an independent auditor who did not qualify to be a participant. The independent researchers and independent auditor were individuals who have conducted their own qualitative or mixed methods research studies in an education program. Independent researchers verified qualitative themes from the open questions. The independent auditor analyzed factors of the entire research study including cohesiveness and conclusions (Creswell, 2014).

Survey

I used and adapted survey items from Roberts's (2010) study. I used survey items from several sections of Roberts's survey, including "Personal Skill Level in Assuring High Levels of Learning" (p. 41), "Team's Skill Level in Creating a Culture of Collaboration" (p. 41), and "Team's Skill Level for Academic Results" (Roberts, 2010, p. 41). I adapted the survey items to the characteristics of the CR district and of the student achievement. In Questions 9-11, I specified "biology student" instead of using the word "student." In Question 12, I inserted the phrase "weekly biology" to read "Rate your weekly biology PLT." In Questions 13, 14, 16, and 17, I inserted the word, "weekly" to read "weekly PLT." In Question 15, I inserted the word, "weekly" and added the phrase "results in biology" to read "Rate your weekly PLT's skill in focusing on academic results in biology." I sought and received permission from Roberts to use and adapt the

PLT instruments (see Appendix B).

The survey for the research study was composed of 20 items. In Items 1 and 2, participants gave consent to use their responses in the dissertation and confirmed that they qualified for the research study respectively. In Item 3, participants gave demographic data.

In Item 3, participants indicated the school where they taught biology in the 2018-2019 school year. I collected the school name to link the survey responses to student achievement data. I collected perceptual data in Survey Items 4-8 to show the different components and structure of biology PLTs across the CR district.

Using Survey Items 4 and 5, I gathered data on the attendees and leader of the biology PLTs. Participants had five choices for all attendees in their weekly PLT meeting in Item 4: only biology teachers, all science teachers, instructional facilitator (IF), school administrator, and other. If a participant chose the answer "other," the participant had an open box to type in the specific title of the attendee. Participants had four choices for who leads weekly PLT meetings in Item 5: teacher, instructional facilitator, school administrator, and other. If a participant chose the answer "other," the participant had an open box to type in the specific title of the leader. The participants answered questions on the duration and frequency of biology PLT meetings at each site in Items 6 and 7.

In Survey Item 6, participants chose the duration of weekly PLT meetings. The choices were 15 minutes or less, 30 minutes, 45 minutes, or 60 minutes or more. In Survey Item 7, participants chose the frequency of PLT meetings per week. The choices were 1, 2, 3, or 4 times. Participants gave perceptual data on the percentage of time spent on different tasks in biology PLTs in Item 8.

I used a task chart from Graham and Ferriter (2010, p. 147) for Survey Item 8. I sought and received permission to use the task chart for the research study (see Appendix C). The tasks within a PLT including in Item 8 were analyzing, comparing, or scoring student work samples, developing common assessments, analyzing assessment data, discussing grade-level or school business priorities (for example, field trips, scheduling, etc.), analyzing instructional practices (for example, critiquing instructional strategies), and planning curriculum or instruction. I included a choice of "other." If participants chose "other," they could write in a function that was not listed in the chart. The choices for percentage of time spent on tasks were 0, 1-10, 11-20, 21-30, 31-40, 41-50, 51-60, 61-70, 71-80, 81-90, 91-100. The next section of the survey collected data on perceptions of DuFour's (2004) first big idea.

In Survey Items 9-11, participants rated their personal skill in assuring high levels of learning, DuFour's (2004) first big idea. Item 9 consisted of six Likert scale questions to rate knowledge, plans, and strategies to assure high learning for students. The six-point Likert scale had the following answers with the weight of the question in parentheses: *strongly disagree* (1), *disagree* (2), *somewhat disagree* (3), *somewhat agree* (4), *agree* (5), and *strongly agree* (6). Item 10 was an open-ended question asking participants to identify their personal strengths that allowed students to learn at high levels. Item 11 was an open-ended question in which participants explained the skills they believed they needed to acquire to help students achieve at high levels. The next section of the survey contained questions on DuFour's second big idea.

In Survey Items 12-14, participants rated their biology PLT's skill level in creating a collaborative culture, DuFour's (2004) second big idea. Item 12 had eight

Likert scale questions in which participants rated group mechanics and actions using common assessments. The 6-point Likert scale had the following choices and weights: *strongly disagree* (1), *disagree* (2), *somewhat disagree* (3), *somewhat agree* (4), *agree* (5), and *strongly agree* (6). Item 13 was an open-ended question in which participants explained the strength their PLT has in creating a collaborative culture. Item 14 was an open-ended question in which participants explained the skills their PLT needs to acquire to create a collaborative culture. The next section of the survey was centered around DuFour's third big idea.

In Survey Items 15-17, participants rated their PLT's skill level in focusing on academic results. Item 15 had five Likert scale questions in which participants rated their PLT on interactions among members and actions for students. The 6-point Likert scale had the following choices and weights: *strongly disagree* (1), *disagree* (2), *somewhat disagree* (3), *somewhat agree* (4), *agree* (5), and *strongly agree* (6). Item 16 was an open-response question that allowed the participant to explain their PLT's strengths in focusing on academic results. Item 17 was an open-ended question in which participants explained the skills their PLT needed to help them focus on academic results. The last section of the survey allowed participants to give information on the impact of working in PLTs on their teaching practices.

In Survey Items 18-20, participants rated, described, and explained the perceived impact of working in PLTs. In Survey Item 18, participants used a Likert scale to rate the impact of participation in PLTs on their teaching practices. The 5-point Likert scale had the following choices and weights: *not impacted* (1), *slightly impacted* (2), *moderately impacted* (3), *very impacted* (4), and *extremely impacted* (5). In Survey Item 18,

participants who reported an impact on their teaching practices chose the type of impact. The Likert scale choices and weights for this item were *positive impact only* (3), *positive and negative impact* (2), and *negative impact only* (1). Item 20 was an open-ended question that allowed participants to explain their answer to Item 18.

Likert Scale

I used weaker choices to accommodate participants who do not have strong opinions on the Likert question and to possibly decrease the incidence of satisficing on the survey. People satisfice when they choose an answer that fits "well enough" but does not completely fit their view. I used weaker responses in place of the midpoint choice of "undecided" used by Roberts (2010). Krosnick and Presser (2010) wrote that "offering a midpoint on a scale may constitute a cue encouraging satisficing to people low in ability and/or motivation, especially if its meaning is clearly either 'neutral/no preference'" (p. 271). "Consequently, offering a midpoint may encourage satisficing by providing a clear cue offering an avenue for doing so" (Krosnick & Presser, 2010, p. 271). Less satisficing may have increased the accuracy of participant responses. Krosnick and Presser also discussed the length of Likert scales.

I used 3-, 5-, and 6-point Likert scales with paired responses. Krosnick and Presser (2010) suggested using "dichotomous response option pairs" (p. 270) such as "'agree' and 'disagree'" (p. 270) supports better understanding of rating scales. Krosnick and Presser noted the length of the Likert scale affected responses to the survey. According to Krosnick and Presser,

> For rating scales up to seven points long, it may be easy to specify intended meanings of points with words, such as "like a great deal," "like a moderate

> amount," "like a little," "neither like nor dislike," "dislike a little," "dislike a moderate amount," and "dislike a great deal." But once the number of scale points increase above seven, point meanings may have become considerably less clear. (p. 270)

Validity of Data Collection

I used several ways to ensure consistency and validity of data collection. I used the same population to contribute qualitative and quantitative data. By using the same population, I addressed the problem of different sample sizes between qualitative and quantitative data (Creswell, 2014). I aligned qualitative and quantitative data constructs. I addressed the reliability and validity of the survey by using independent evaluators to critique the survey and by aligning the survey items to the research questions. I triangulated data sources. The figure shows the alignment among survey items, research questions, and DuFour's (2004) three big ideas.

Figure

Alignment of Survey Items with Research Questions

Survey items to confirm consent and eligibility to take survey		
Survey items	Type of question	Answer choices
1. This anonymous survey is part of a dissertation research study on professional learning teams (PLTs). By answering the questions on this survey, you give consent to use your responses being used for dissertation purposes. Your responses will remain anonymous unless you disclose your information.	Single choice	I understand this statement and consent to the use of my responses for dissertation purposes.
2. I verify that I have taught at least one complete course of biology (the EOC course) in the school district during the 2018-2019 school year.	Single choice	Yes, I verify the statement. (Logic skips to the next section) No, I do not verify the statement (The survey will end) (Logic ends the survey)
Survey Items to Gather Demographic Data and PLT Structure		
Survey items	Type of item	Answer choices
3. Choose the school where you taught the biology course(s) in the 2018-2019 school year.	Dropdown menu	District schools listed
4. How long does a PLT meeting usually last?	Radio button	15 minutes or less 30 minutes 45 minutes 60 minutes or more
5. How many times does your PLT meet each week?	Radio button	1 2 3 4
6. Who attends the weekly PLT meeting at you school site?	Check boxes Open-ended question	Only biology teachers All science teachers Instructional facilitator Administrator Others (please specify)
7. Who leads weekly PLT meetings?	Radio button Open-ended question	Teacher Instructional facilitator Administrator Other (please specify)

8. What percentage of time is spent on each task at PLT meetings? A. Analyzing, comparing, or scoring student work samples B. Developing common assessments C. Analyzing assessment data D. Discussing grade-level or school business priorities (for example, field trips, scheduling, etc.) E. Analyzing instructional practices (for example, critiquing instructional strategies) F. Planning curriculum or instruction G. Other (please specify in the comment box)	Radio button Open-ended question	0% 1-10 11-20% 21-30% 31-40% 41-50% 51-60% 61-70% 71-80% 81-90% 91-100%

Research questions	Survey items aligned with research questions Personal skill in ensuring students learn
1. How do biology teachers perceive their personal skill level in assuring that all students learn at high levels?	9. Rate your personal skill in ensuring biology students learn. [*strongly disagree, disagree, somewhat disagree, somewhat agree, agree, strongly agree*] Actions A. I know the essential objectives all students need to learn in my classroom. B. I know when each student has mastered the essential objectives. C. I have a plan for responding to students, who experience difficulty. D. My personal response for students who struggle is supported through research-based intervention. E. My personal interventions require students to devote extra time to skills to assure mastery. F. I provide enrichment for those students who have already mastered the content. 10. What personal strengths do you believe you have to ensure biology students learn at high levels? 11. What skills do you believe you still need to acquire to help biology students achieve at high levels?
2. How do biology teachers perceive their PLT's skill level in creating a collaborative culture?	12. Rate your **<u>weekly</u>** biology PLT's skill in creating a collaborative culture. [*strongly disagree, disagree, somewhat disagree, somewhat agree, agree, strongly agree*] Actions A. My PLT team clarified roles and responsibilities. B. My PLT team clarified norms. C. My PLT team collectively decided upon essential outcomes linked to state/district standards. D. My PLT team created common formative assessments related to the essential outcomes. E. My PLT team created common summative assessments related to the essential outcomes. F. My PLT team determined common standards of mastery for proficiency of the essential outcomes.

	G. My PLT team examines the results from our common assessments. H. My PLT team develops new teaching strategies based on the common assessment results. 13. What are the strengths of the **weekly** PLT that have helped to create a collaborative culture? 14. What skills do you believe your **weekly** PLT still needs to acquire to help create a collaborative culture?
3. How do biology teachers perceive their PLT's skill level in focusing on academic results?	15. Rate your **weekly** PLT's skill in focusing on academic results in biology. [*strongly disagree, disagree, somewhat disagree, somewhat agree, agree, strongly agree*] Actions A. My PLT team is able to honestly confront the brutal facts regarding our students' achievement data. B. My PLT team is able to determine our students' current level of achievement. C. My PLT team focuses on student learning rather than on teaching. D. My PLT team discusses evidence of student academic progress at each PLT team meeting. E. My PLT team members are able to hold each other accountable for the results that lead to continuous student improvement. 16. What are the strengths of the **weekly** PLT that have helped the PLT focus on academic results? 17. What skills do you believe your **weekly** PLT still needs to acquire to assist in focusing on results?
4. To what extent do biology teachers believe their teaching practices were impacted as result of working in PLTs?	18. Rate the impact of participation in your **weekly** PLT on your teaching practices. [*not impacted, slightly impacted, moderately impacted, very impacted, extremely impacted*] 19. IF your teaching practices were impacted by your participation in your weekly PLT meeting, describe the type of impact. [*positive impact only, positive and negative impact, negative impact only*] 20.Explain why you choose that degree of impact.

I gathered quantitative and qualitative data with parallel variables (Creswell, 2014), meaning both types of data addressed the same topic. Using parallel variables is important to validity in mixed methods design (Creswell, 2014). Using parallel variables decreases complications in combining qualitative and qualitative data results (Creswell,

2014). The online survey was distributed via email.

GLP Percentages

I collected biology achievement data from the accountability services page of the NCDPI website. NCDPI converts student raw scores into achievement levels from 1 through 5, the lowest and highest levels respectively. Students achieve GLP on a state summative biology test when they score from a level 3 to a level 5 (NCDPI, 2017). The state education department reports the percentage of students who achieve GLP. NCDPI requires each school and district to maintain specific proficiency percentages to prevent the state from intervening in the operation of the school. I reported the GLP percentages by ranges. I grouped each participating school into one of three ranges according to the GLP percentage: low GLP range (<5-33%), medium GLP range (45-65%), and high GLP range (80->95%). The GLP percentage for the state is 60.1% for the 2018-2019 school year.

Data Collection

The data collected were perceptual teacher quantitative and qualitative data via an online survey housed in the SurveyMonkey website. Participants accessed the survey by a link embedded in an email. I emailed the informed consent form and survey link to the director of the science program. Participants clicked the survey link and began the survey in the SurveyMonkey website. The survey began with a notification of the use of the survey and garnered permission to use their responses. Participants could not continue the survey unless they consented. Participants were able to exit the survey at any time. Participants confirmed that they taught biology in the CR district for at least one complete semester within the 2018-2019 school year. The demographic data in the survey

was limited to the name of the high school in which the participant taught the biology course. The demographic data allowed me to link the teacher perceptions with the achievement data. After linking the survey data to achievement data, each school site was assigned a randomized number using an online random number generator to preserve anonymity of participants. The survey results are secured data because I am required to log into the SurveyMonkey website to access the survey results. SurveyMonkey is a secure site. I was the only person with login access to the survey results.

The quantitative data in the form of GLP percentages were collected from data sources on the accountability services webpage of the NCDPI website. NCDPI website houses school level summary data result reports. The data results were downloaded reports for the 2018-2019 school year. I analyzed the association between teacher perceptions related to DuFour's (2004) three big ideas and biology GLP percentages at the school level. I grouped the GLP percentages by ranges. I used DuFour's big ideas to guide data collection and analysis.

Data Analysis

As with Roberts's (2010) study, the three independent variables in this study were biology teacher perceptions of three things—their personal skill level in assuring that all students learn at high levels, their weekly PLT's skill level in creating a culture of collaboration, and their weekly PLT's skill level in focusing on academic results. Roberts used the percentage of proficient scores per standard for math, reading, and English for fourth, eighth, and 12th graders as dependent variables. I used GLP percentage ranges from overall performance on the state biology test per participating school for dependent variables. The biology achievement data were primarily from ninth and 10th graders. As

with Roberts, I used demographic data to link survey answers to achievement data. Unlike Roberts, I only required the name of the school where the participant taught biology during the 2018-2019 school year. Demographic data were limited to the name of the school to protect the anonymity of the data. Twelve schools participated in the research study. I used the mean, total range, percentage, one-way analysis of variance test (ANOVA), and Fisher's Exact test (Exact test) for statistical analysis of quantitative data and used theme coding for analysis of qualitative data. SurveyMonkey functions provided help to organize and analyze data.

SurveyMonkey functions were used to assign a weight to each Likert scale answer choice. The SurveyMonkey functions calculate the mean and standard deviation of participant responses across each statement of Likert items. I used the SurveyMonkey information to calculate the total mean for the entire Likert item and GLP percentage ranges and to calculate the total range for GLP ranges. I used the mean because Roberts (2010) used means. Using means gave me a way to compare results with Roberts. "The mean (or average) is [a type of]…measure of central tendency" (Lund Research Ltd, 2018a, para. 3). The range provided a "measure of spread" (Lund Research Ltd, 2018b, para. 1) to "describe the variability in a sample or population" (Lund Research Ltd, 2018b, para. 1). "A measure of spread gives us an idea of how well the mean, for example, represents the data" (Lund Research Ltd, 2018b, para. 2). Targeted responses had lower ranges as they indicate close data points (Lund Research Ltd, 2018b) and consistency in responses.

I used an Exact test because of the small sample size in the research study. In the research study, the 16 participants from a pool of 45 biology teachers took the survey.

Though participants responded at a rate of 35%, which is above the average response rate (Ramshaw, n.d.), in general, the sample size was small. Small sample sizes can present a challenge in statistical data in detecting associations. The Exact test is useful for small sample sizes (Cleophas & Zwinderman, 2016) to determine the probability of getting the response sets (McDonald, 2014) and "assess for independence between two variables when the comparing groups are independent and not correlated" (Hae-Young, 2017, p. 152). The *p* value for the Exact test is $p<0.05$. The *p* value is the point at which the data are considered statistically significant.

Like Roberts (2010), I calculated the mean of Likert scale data and tested for statistical significance difference of the means among participants and among each school site. I tested for statistical significance for the Likert items for all of DuFour's (2004) three big ideas. Roberts tested for significance for the third big idea of focusing on academic results. Means are calculated for Survey Items 9, 12, 15, and 18. A one-way ANOVA test determines significant differences among the means of responses per school. "One-way ANOVAs compare the means between the groups you are interested in and determines whether any of those means are statistically significantly different from each other" (Lund Research Ltd, 2018c, para. 2). An ANOVA "is used to determine whether there are any statistically significant differences between the means of three or more independent (unrelated) groups" (Lund Research Ltd, 2018c, para. 1). In the research study, the specific groups were specific schools. I collected qualitative data in open-ended questions on the teacher survey.

Survey Items 10, 11, 13, 14, 16, 17, and 20 were open questions and provided qualitative data. The questions allowed participants to indicate existing strengths, noted

skills needed, and explained Likert scale answers. Qualitative data allow participants to express information in their own voice. I identified themes in the open responses and manually coded responses according to identified themes.

Like Roberts (2010), I manually coded themes according to each of DuFour's (2004) big ideas. Open Questions 10 and 11 provided responses about DuFour's first big idea. Open Questions 13 and 14 provided responses focused on DuFour's second big idea. Open Questions 16 and 17 provided responses concerning DuFour's third big idea. Open Item 20 provided responses on participant perceptions of PLT impact on their teaching practices. I used independent evaluators who did not qualify as participants to verify identified themes. The independent evaluators did not qualify to be participants because they do not work in the CR district and did not teach the high school biology course. The independent evaluators are educational researchers from state and private institutions of learning who have done doctoral research. I emailed the qualitative data for each one of DuFour's big ideas to one independent researcher. In other words, I sent the qualitative data for DuFour's first big idea to one researcher, sent the qualitative data for DuFour's second big idea to another researcher, and sent the qualitative data for DuFour's third big idea to yet another researcher. The independent researchers emailed their responses back to me. I emailed the qualitative data for Item 20 to two independent researchers because the question had more components than other open items. The two independent evaluators emailed their responses back to me. The independent evaluators coded the data separately from me. Information that was mentioned by at least two participants was considered a theme. The reason for using a minimum of two participants was to prevent outliers. Outliers are results that do not align with themes of other results

(Foss & Waters, 2016; Salkind, 2010). I compared the identified themes I found to each independent evaluator's identified themes. The verified themes presented in the research study are the themes identified and agreed upon by both the independent evaluators and me. I compared the number of participants who expressed the theme to show the strength of themes relative to each other. I analyzed the quantitative data and qualitative data within each big idea (DuFour, 2004) to look for trends, contradictions, and explanations among the data types. I used GLP percentages from state test data as the dependent variable.

The dependent variables in the research were the GLP percentages from overall biology state test performance for each participating school. Participating schools were grouped into one of three GLP percentage ranges, namely low GLP range (<5-33%), medium GLP range (45-65%), and high GLP range (80->95%). The GLP percentage for the state is 60.1% for the 2018-2019 school year. An Exact test was used to determine if teacher responses were related to the state test GLP percentages. A one-way ANOVA statistical test was used to determine if the averages of the responses among biology teachers from different schools were significantly different.

Summary

Chapter 3 contained explanations of the parameters of the research study inclusive of the setting, research design and rationale, and methodology. I conducted a study to determine associations between teacher perceptions of PLT functions according the DuFour's (2004) three big ideas and student achievement on a state summative test in biology. I conducted the study in the CR district in North Carolina. Within the district, various educators and school staff on all levels affect the functions of PLTs and push for

PLT development. The focused was on PLT development for biology teachers and biology student achievement. The focus on achievement and progress in biology supports the state and national efforts to increase and improve science learning. Improvement in science learning can help the nation compete in a global market.

I used a convergent, mixed methods design for the research study. I conducted an extension of Roberts's (2010) study using major portions of Roberts's research questions and design. I approached the study from using a postpositivistic viewpoint and looked for associations. Like Roberts, I used DuFour's (2004) big ideas as a model for PLT structure. The research study addressed the question of the association between biology teacher perceptions of PLT factors and student achievement in biology.

The survey is an anonymous, online instrument used to collect qualitative and quantitative biology teacher perceptual data. The survey is housed in SurveyMonkey.com. The director for the science program distributed the recruitment email that contained the consent form and link to the survey to biology teachers. The link in the email directed the participants to the survey in SurveyMonkey.com. Participants established their eligibility on the first questions in the survey. The participants for the research were biology teachers in the CR district. I calculated means, percentages, and ranges of Likert responses and coded themes for open responses. I collected student achievement data from the accountability services webpage of NCDPI in the form of GLP percentages and reported the data in ranges.

Chapter 4 is a presentation of the perceptual and achievement data from the research study. The perceptual data points are teacher survey responses to the Likert scale and open-response questions, and the achievement data are biology GLP percentage data

from the NCDPI website. Statistical analyses of quantitative data and themes of qualitative data sources are reported.

Chapter 4: Results

Introduction

The gathered data show the impact of biology teacher participation in PLTs on teacher skills and student achievement. Using the online survey, I gathered perceptual data from biology teachers in the CR school district who taught during the 2018-2019 school year. The research study has multistage sampling by the accessing of participants through the director of the science department at the district office (Creswell, 2014). Data were gathered with Likert and open questions centered on DuFour's (2004) three big ideas about PLTs. Participants answered questions about the impact of participation in PLTs on teaching practices. The gathered quantitative and qualitative perceptual data were compared to state biology student achievement data from the CR district. The central research question guiding the study was, "How has student achievement been impacted when educators worked in PLTs?" The supporting research questions were

1. How do biology teachers perceive their personal skill level in assuring that all students learn at high levels?
2. How do biology teachers perceive their PLT's skill level in creating a culture of collaboration?
3. How do biology teachers perceive their PLT's skill level in focusing on academic results?
4. To what extent do biology teachers believe their teaching practices have been impacted as a result of working in PLTs?
5. What is the association between teacher perceptions of PLTs and student achievement in biology?

Quantitative and Qualitative Data Analysis

Demographic and PLT structure perceptual data were collected in Survey Items 3-8 to show the specific school site and different components and structure of biology PLTs across the CR district. Sixteen of the 45 biology teachers participated in the research study, a response rate of 35%. The 16 teachers represented 12 schools in the CR district. The 16 teachers completed the required portion of the survey (Items 3-8).

In Survey Item 3, participants indicated their school site. In Survey Items 4 and 5, participants named the attendees and leader of their biology PLTs. Table 3 shows the results from Survey Items 4 and 5 disaggregated by school site.

Table 3

Results from Survey Items 4 and 5 by School

Schools in randomized order	Attendees of the PLT meeting					Leads the PLT
	Only biology teacher	All science teachers	Instructional facilitator (IF)	School administrator (School admin)	Other	
1	X		X			IF
2	X		X	X		IF
3		X	X	X		IF
4	X			X		School admin
5	X		X		Instructional coaches	Teacher
6	X		X	X	Instructional coaches	Teacher
7		X	X	X		Teacher
8	X		X	X		Teacher/IF
9		X	X	X	Teachers in other content areas	IF
10		X	X	X	Support staff like exceptional children personnel & media personnel	IF
11	X		X			IF
12	X		X	X		Teacher/IF

Table 3 gives a view of PLT structure by school site. Of the 12 participating schools, nine sites had one participant, two sites (Schools 10 & 12) had two participants, and one site (School 8) had three participants. There were some differences between the responses of participants at the same school. The three participants in School 8 gave the same response for attendees of the PLT, but two participants reported the leader as the teacher, and one participant reported the leader as an IF. The two participants in School

10 gave the same response for attendees and the leader of the PLT, except one participant reported the presence of exceptional children and media personnel, and the other participant did not. The two participants in School 12 gave the same answers about attendees of the PLT, but one participant reported the PLT leader as a teacher, and the other participant reported the PLT leaders as a teacher and IF.

PLT structure varies across the participating schools. Eight schools reported biology teachers as the only content teachers, and four schools reported all science teachers are present as content teachers. Three of the 12 schools reported the presence of an IF in PLT meetings, one school reported the presence of a school administrator, and eight schools reported the presence of both an IF and a school administrator. Four schools reported the presence of other educators in the PLT such as instructional coaches, teachers in other content areas, exceptional children personnel, and media personnel. In this research study, I am reporting teacher perceptual data; but as a member of the CR district, I am aware that some schools that have instructional coaches from district office present at some PLT meetings did not report the presence of instructional coaches. Various types of instructional coaches from the district office participate in varying frequencies in PLTs of schools across the district. Reasons for omitting the instructional coach from the list of PLT attendees could be participant understanding of the survey item (listing only people who consistently attend PLTs or only people who are based in their building) or it could be an oversight of the participants. Six of the 12 schools reported an IF leads the weekly PLT, three schools reported a teacher leads the PLT, two schools reported that both an IF and a teacher lead, and one school reported a school administrator leads. In total, eight of the 12 schools reported an IF involved in leading

weekly PLTs in the CR district.

Table 4 shows the results from Survey Items 6 and 7 disaggregated by number of schools. The items show the duration and frequency of biology PLT meetings.

Table 4

Results to Survey Items 6 and 7 by Number of Schools.

Time spent in PLT (15 min or less, 30 min, 45 min, or 60 min or more)	Number of times the PLT meets per week (1, 2, 3, or 4)	Number of schools
30/45	2	1
45	1	9
45	3	1
60 or more	2	1

The CR district requires each school to meet in PLTs at least 45 minutes per week. Table 4 shows nine schools reported one 45-minute PLT meeting per week, which is the basic requirement for the district. In one school, both participants reported two weekly meetings, but one participant reported the meeting time as 30 minutes and the other participant reported the meeting time as 45 minutes. The total time for PLT meetings per week ranged from 45 minutes to over 2 hours in total. I reported the duration and frequency of the weekly PLTs separately from the attendees and leaders of the weekly PLTs to preserve the confidentiality of the information.

In Item 8, participants gave perceptual data on the percentage of time spent on different tasks in weekly PLTs. The PLT task chart from Graham and Ferriter (2010, p. 147) was the basis for possible responses. Table 5 shows the raw data for perception of time use in weekly PLTs by percentages by site.

Table 5

Results for Survey Item 8 by Number of Schools

Tasks in PLT meetings	Number of schools reporting percentage of time spent on tasks; n=12										
	% of Time	0%	1-10%	11-20%	21-30%	31-40%	41-50%	51-60%	61-70%	71-80%	81-90%	91-100%
Analyzing, comparing, or scoring student work samples		3.5	2	3.5	2	0	1	0	0	0	0	0
Developing common assessments		5	.5	2.5	1	2	0	0	0	1	0	0
Analyzing assessment data		1.5	1	3.5	2	3	.5	.5	0	0	0	0
Discussing grade-level or school business priorities (for example, field trips, scheduling, etc.)		6	4.5	1.5	0	0	0	0	0	0	0	0
Analyzing instructional practices (for example, critiquing instructional strategies)		2.5	2.5	2.5	2	2.5	0	0	0	0	0	0
Planning curriculum or instruction		1.5	1.5	2.5	5	1.5	0	0	0	0	0	0
Other (please specify in the comment box)		11	.5	0	0	.5	0	0	0	0	0	0

In Table 5, participants chose percentage of time use in increments of 10. Data are arranged by site. In the event respondents at the same site selected different percentages of time, each selection is represented as .5 of the site. As a result, some schools are represented as .5 in different percentages of time. Cumulatively across each task row, all

12 school sites are represented. The results show a wide variety of time use combinations among biology PLTs. Analyzing assessment data and planning curriculum or instruction are reported in PLTs for the 10.5 of 12 sites, or 87.5%. One school site spends 71-80% of the time developing common assessments in PLTs. The tasks with the lowest percentages of time were other and discussing grade-level or school business priorities. Of participating schools, 8.3%, or one of 12, reported doing other task outside of the listed PLT tasks. The tasks included "Closing the gap between our student subcategories [and] professional development tools" and "[Occupational curriculum studies] OCS support." For the task of discussing grade-level or school business priorities, 37.5% of schools (4.5 of 12) reported 1-10% time on the task and 12.5% (1.5 of 12) reported 11-20% time on the task. I reported the result by number of schools to preserve the anonymity of participants.

Perceptual quantitative data with Likert scales scores came from Survey Items 9, 12, 15, 18, and 19, with means, percentage of responses, Exact tests, and ANOVAs used to analyze the data. As in Roberts's (2010) study, the mean was used to express the central tendency of results to Likert scale questions. An ANOVA "is used to determine whether there are any statistically significant differences between the means of three or more independent (unrelated) groups" (Lund Research Ltd, 2018c, para. 1). In the research study, the independent (unrelated) groups were specific schools. ANOVA results are relevant to Research Questions 1-3. Exact tests determine the probability of getting a response set (McDonald, 2014) and the independency of the response set (Hae-Young, 2017) from other factors. In this research study, the Exact test determines the probability of a school getting a Likert mean and the independency of that mean from the GLP

percentage range. The Exact test results are relevant to Research Question 5. Perceptual qualitative data came from open Survey Items 10, 11, 13, 14, 16, 17, and 20. I used a hierarchical and interactive (Creswell, 2014, p. 197) approach to analyzing the qualitative data. The data were coded by themes while noting which participant response matched each theme. DuFour's (2004) three big ideas were used to group the themes. Independent educational researchers from state and private institutions verified the themes as described in Chapter 3. All verified themes from the research study are in Appendix D. Participants could opt out of answering Items 9-20. Fourteen of the 16 participants answered Items 9-20. Having 14 participants of the 45 teachers who were eligible to participate in the study gave a response rate of 31%. The 14 participants represented 11 schools.

Research Question 1: How Do Biology Teachers Perceive Their Personal Skill Level in Assuring That all Students Learn at High Levels?

Data from Items 9-11 were used to answer Research Question 1. In Item 9, participants rated their skills in ensuring students learn. Survey Item 9 was, "Rate your personal skills in ensuring biology students learn at high levels." Table 6 shows the raw data by the number and percentage of responses of the14 participants. Each row adds up to 14 participants and 100%. Each Likert scale choice is followed by the weight of the response in parentheses. The response of *strongly agree* has the greatest weight of 6 points and the response of *strongly disagree* has the smallest weight of 1 point. The mean and standard deviation are calculated for each statement. The standard deviation is provided to give additional context to the mean.

Table 6

Results for Survey Item 9 by Participant

Strongly agree (6)	Agree (5)	Somewhat agree (4)	Somewhat disagree (3)	Disagree (2)	Strongly disagree (1)	Mean (6-point scale)	Standard deviation
Number and *percentage* of responses *from participants*; *n=14*							
9A. I know the essential objectives all students need to learn in my classroom.							
62.3% 9	28.6% 4	7.1% 1	0.0% 0	0.0% 0	0.0% 0	5.57	0.62
9B. I know when students have mastered the essential standards.							
21.4% 3	57.1% 8	21.4% 3	0.0% 0	0.0% 0	0.0% 0	5.00	0.65
9C. I have a plan for responding to students, who experience difficulty.							
28.6% 4	50.0% 7	21.4% 3	0.0% 0	0.0% 0	0.0% 0	5.07	0.70
9D. My personal response for students who struggle is supported through research-based intervention.							
21.4% 3	50.0% 7	21.4% 3	7.1% 1	0.0% 0	0.0% 0	4.86	0.83
9E. My personal interventions require students to devote extra time to skills to assure mastery.							
28.6% 4	50.0% 7	21.4% 3	0.0% 0	0.0% 0	0.0% 0	5.07	0.70
9F. I provide enrichment for those students who have already mastered the content.							
21.4% 3	57.1% 8	14.3% 2	7.1% 1	0.0% 0	0.0% 0	4.93	0.80
Total personal skill level mean						5.08	0.23

All participants chose some level of *agree (somewhat agree, agree, or strongly agree*) with all Statements 9A-F except for two responses of *somewhat disagree*—one on Statement 9D and one on 9F. There were 82 *agrees* of the 84 responses, or 98% of

agrees. The average mean for Item 9 is 5.08, indicating that on average, participants reported their skill in ensuring students learn as *agree* to *strongly agree*. Statement 9A is "I know the essential objectives all students need to learn in my classroom." Statement 9A is above the total mean for Item 9 and Statements B-F are below the total mean. Statement 9A has the highest mean of the Item 9 statements and the highest possible percentage of responses in a level of *agree*. Of the responses to 9A, 62.3% were *strongly agree* responses.

Statements 9D and 9F show the lowest percentage of responses in a level of *agree*. Statement 9D is "My personal response for students who struggle is supported through research-based intervention" and Statement 9F is "I provide enrichment for those students who have already mastered the content." Statements 9D and 9F have the lowest percentage of responses in a level of *agree*—92.9% and 92.8% respectively. The 0.1 difference between the percentages is due to a rounding error as both 9D and 9F have 13 of 14 responses in a level of *agree*. Statement 9D has a lower mean than Statement 9F, showing that answers for 9D are lower on average.

Table 7 shows the statistical analysis per statement of Item 9. Statistically significant numbers are in bold type. For the Exact test and ANOVA, the *p* value is $p<0.05$.

Table 7

Statistical Data for Survey Item 9

Survey item 9: Rate your personal skills in ensuring biology students learn at high levels.		Exact Test	ANOVA
		One-side Pr >= P	Pr > F
A.	I know the essential objectives all students need to learn in my classroom.	0.0898	**0.0353**
B.	I know when each student has mastered the essential objectives.	0.3953	0.1402
C.	I have a plan for responding to students, who experience difficulty.	0.6047	0.5993
D.	My personal response for students who struggle is supported through research-based intervention.	0.6047	0.0965
E.	My personal interventions require students to devote extra time to skills to assure mastery.	0.6047	0.4012
F.	I provide enrichment for those students who have already mastered the content.	0.3953	0.6567

The Exact test does not show statistical significance for any statements in Item 9. The difference in response means among schools for Statement 9A is statistically significant for the ANOVA.

Reported data are disaggregated by number of schools for Statement 9A because 9A shows statistical significance for the ANOVA. The data for Item 9A are disaggregated by the number of school sites in Table 8 because the ANOVA compares the means of schools. For schools with more than one participant, responses were averaged, leaving one school mean between Likert scale responses, represented by 5.5.

Table 8

Mean Scores for Statement 9A by Number of School Sites

Mean Likert scale scores	9A
	Number of schools
4.0	1
5.0	2
5.5	1
6.0	7
Total	11

In Table 8, 100% of schools chose a level of *agree* with 64%, or seven of 11 schools, showing a mean of 6.0 *strongly agree*.

Items 10 and 11 inform Research Question 1. Table 9 displays the qualitative data for Items 10 and 11. The table shows verified themes in each item along with the number and percentage of participants who expressed the theme. Information was considered a theme if at least two participants mentioned the information. Item 10 shows perceived strengths and Item 11 shows perceived needs. Of the 14 participants, the same 13 participants answered Items 10 and 11. The strength of the theme is established by the number of participants who expressed the theme compared to other themes.

Table 9

Qualitative Data Themes for Survey Item 10 and 11 by Participant

Survey items	Number of participants	Percentage of participants; n=14	Verified themes
10. What personal strengths do you believe you have to ensure students learn at high levels?	4	28.6	Relationships with students
	2	14.3	Application of the concepts
	3	21.4	Teachers aware that students are on different educational levels
11. What skills do you believe you still need to acquire to help students achieve at high levels?	4	28.6	Differentiation for different populations
	2	14.3	Improvements in labs
	3	21.4	Student accountability/learner buy-in

The relationships with students theme was the greatest perceived strength compared to the other verified strength themes in Item 10. The relationship with students theme was expressed by four of 14 participants, or 28.6% of participants. Excerpts of participant responses for relationships with students are “developing relationships to help motivate them [students]” and “You must be able to build relationships with students and build trust.” The application of the concepts theme was the smallest perceived strength. The application of the concepts theme was expressed by two of the 14 participants, or 14.3% of participants. Excerpts of participant responses for the application of the concepts theme are “I have real life science lab experience to draw on and relate to topics in the biology standards” and “I am good at developing projects to help higher level students really showcase what they know in an engaging way.” Excerpts of participant responses for the teachers being aware that students are on different educational levels theme are “Pushing students further regardless of their level,” “I am good at developing projects to help higher level students,” and “Trained in special education practices.”

The greatest perceived need theme compared to other need themes of Item 11 is differentiation for different populations. The differentiation for different populations theme was expressed by four of 14 participants, or 28.6%. Teachers expressed awareness of student differences in their strengths but perceived they were not meeting all educational needs of different populations. Excerpts of participant responses for the differentiation for different population theme are "Continue getting better differentiating, especially for our growing EL [English Learners] population" and "How to effectively differentiate to students of all levels, individually (not really possible)." The smallest perceived need theme compared to other need themes of Item 11 is improvements in labs. The improvements in lab theme was expressed by two of 14 participants, or 14.3%. Excerpts of participant responses for the improvements in labs theme are "Better labs" and "More access to lab materials." Excerpts of participant responses for the students accountability/ learner buy-in theme are "Reaching students who receive little to no academic accountability or check in at home to be able to get to proficiency" and "How to get more buy-in from unmotivated learners."

In summary, Research Question 1 focused on how biology teachers perceive their personal skill level in ensuring all students learn at high levels. Biology teachers in the CR district perceive they have a high skill level in assuring that all students learn at high levels. The evidence is 97% *agree* for Item 9 and a total mean of 5.08 that is slightly above the *agree* level. Biology teachers perceive they know essential objectives that students need to learn in their classrooms and can apply the concepts. This conclusion is supported by Statement 9A that has 100% of responses in a level of *agree* with 62.3% of responses in *strongly agree* and the highest mean of 5.57; 64% of school means are at the

strongly agree level. This conclusion is also supported by qualitative data through the verified strength theme of application of the concepts, where 14.3% of participants expressing the theme. Verified strengths show teachers believe they do well in recognizing students are on different academic levels and in forming relationships with their students.

Biology teachers feel they are weaker at having personal responses for students who struggle that are supported through research-based interventions. The supporting results are in Statement 9D with the lowest percentage of responses in a level of *agree* at 92.9 and the lowest mean of 4.86. Participants also perceive they are relatively weaker in providing enrichment for those students who have already mastered the content. The supporting results are from Statement 9F with the lowest percentage of total responses in a level of *agree* at 92.9% and the next lowest mean of 4.93. Biology teachers are aware of different learners, as evidenced by a verified strength theme with 21.4% of participants reporting. They are also aware that they need support to meet the needs of different learners as evidenced by a verified need theme with 28.6% of participants expressing the theme. Biology teachers see the need for greater student accountability and learner buy-in and improvements in labs to ensure all students learn at high levels. This statement is evident from two verified need themes with 21.4% of participants reporting and 14.3% of participants reporting respectively.

Research Question 2: How Do Biology Teachers Perceive Their PLT's Skill Level in Creating a Collaborative Culture

Items 12-14 inform Research Question 2. Table 10 shows the raw data by the number and percentage of responses of the 14 participants who completed Item 12.

Survey Item 12 is, “Rate you weekly PLT’s skills in creating a collaborative culture.” Each row adds up to 14 participants and 100%. Likert scale choices are followed by the respective weight in parentheses. The mean and standard deviation were calculated for each statement.

Table 10
Results for Survey Item 12 by Participant

Strongly agree (6)	Agree (5)	Somewhat agree (4)	Somewhat disagree (3)	Disagree (2)	Strongly disagree (1)	Mean 6-point scale	Standard deviation
Number a*nd percentage* of responses; *n=14 participants*							
12A. My PLT clarified roles and responsibilities.							
35.7% 5	21.4% 3	14.3% 2	14.3% 2	7.1% 1	7.1% 1	4.43	1.59
12B. My PLT clarified norms.							
35.7% 5	21.4% 3	28.6% 4	0.0% 0	7.1% 1	7.1% 1	4.57	1.50
12C. My PLT collectively decided upon essential outcomes linked to state/district standards.							
35.7% 5	35.7% 5	14.3% 2	7.1% 1	7.1% 1	0.0% 0	4.86	1.19
12D. My PLT created common formative assessments related to the essential outcomes.							
28.6% 4	14.3% 2	21.4% 3	21.4% 3	14.3% 2	0.0% 0	4.21	1.42
12E. My PLT created common summative assessments related to the essential outcomes.							
28.6% 4	21.4% 3	14.3% 2	14.3% 2	21.4% 3	0.0% 0	4.21	1.52
12F. My PLT determined common standards of mastery for proficiency of the essential outcomes.							
14.3% 2	28.6% 4	14.3% 2	28.6% 4	14.3% 2	0.0% 0	4.00	1.31
12G. My PLT examines the results from our common assessments.							
21.4% 3	50.0% 7	14.3% 2	7.1% 1	7.1% 1	0.0% 0	4.71	1.10

(continued)

12H. My PLT develops new teaching strategies based on the common assessment results.

Strongly agree (6)	Agree (5)	Somewhat agree (4)	Somewhat disagree (3)	Disagree (2)	Strongly disagree (1)	Mean 6-point scale	Standard deviation
Number a*nd percentage* of responses; *n=14 participants*							
14.3% 2	28.6% 4	21.4% 3	21.4% 3	7.1% 1	7.1% 1	4.00	1.41
Total PLT skill in creating collaborative culture mean						4.37	0.30

This item has a wider range of responses than the previous item with at least five of the six possible responses chosen by participants for each item statement. Most responses are a level of *agree*, meaning a response was *somewhat agree*, *agree*, or *strongly agree* (81 *agrees* of 112 responses, 72%). The total mean of Item 12 (4.37) is lower than the total mean of Item 9 (5.08), showing a weaker perception of skill for creating a collaborative culture than for ensuring all students learn at high levels. A total mean of 4.37 shows that on average, participants reported *somewhat agree* to *agree* for their weekly PLT's skill in creating a collaborative culture. Statements 12A-C and 12G are above the total mean for Item 12; and statements 12D-F and 12H are below the total mean for Item 12. Statement 12C is "My PLT collectively decided upon essential outcomes linked to state/district standards." Statement 12C has the highest mean at 4.86. Statement 12C shares the highest percentage of responses in a level of *agree* with Statement 12G. The percentage is 85.7%, or 12 agrees of 14 responses. Statement 12G is "My PLT examines the results from our common assessments." Statement 12G has the next highest mean of 4.71.

The lowest percentage of answers for level of *agree* is in Statement 12F at eight *agrees* of 14 responses, or 57.2%. Statement 12F is "My PLT determined common standards of mastery for proficiency of the essential outcomes." Statement 12F shares the

lowest Likert mean of 4.00 with 12H. Statement 12H is “My PLT develops new teaching strategies based on the common assessment results.” For 12H, the percentage of responses with a level of *agree* is 64.3% or nine *agrees* of 14 responses. Statements 12D and 12E have a 64.3% of response in a level of *agree* or nine *agrees* of 14 responses but have a higher Likert mean than 12H at 4.21. The higher mean shows that the responses for 12D and 12E were on average higher than the responses for 12H.

Table 11 displays the Exact test and ANOVA results per statement for Survey Item 12. Statistically significant numbers are in bold type.

Table 11

Statistical Data for Survey Item 12

Survey item 12: Rate your weekly PLT's skill in creating a collaborative culture.	Exact test	ANOVA
	One-sided Pr >= P	Pr > F
A. My PLT clarified roles and responsibilities.	**0.0287**	0.3234
B. My PLT clarified norms.	**0.0287**	0.7935
C. My PLT collectively decided upon essential outcomes linked to state/district standards.	0.2120	0.0821
D. My PLT created common formative assessments related to the essential outcomes.	**0.0065**	0.7369
E. My PLT created common summative assessments related to the essential outcomes.	**0.0287**	0.0538
F. My PLT determined common standards of mastery for proficiency of the essential outcomes.	0.0898	0.6970
G. My PLT examines the results from our common assessments.	0.6047	0.2037
H. My PLT develops new teaching strategies based on the common assessment results.	0.0898	0.9268

Items 12A, B, and D show statistical significance for the Exact test. Item 12E shows statistical significance for the Exact test. Even though the ANOVA for 12E is not below .05, it bears mentioning because it is close to the *p* value.

Table 12 shows disaggregated data for 12E by the number of schools because the ANOVA was close to the p value. The table shows the average mean for each school leaving some mean scores between Likert scale scores.

Table 7

Mean Scores of Statement 12E by Number of School Sites

Mean Likert scale scores	12E
	Number of schools
1.5	0
2.0	1
2.5	1
3.0	0
3.5	0
4.0	2
4.5	1
5.0	3
5.5	0
6.0	3
Total	11

Statement 12E has a greater number of schools with a mean score in a level of *agree* at nine of 11 responses, or 82%. Though Statement 12E does not emerge as a strength when considering participants individually, it does show to be a strength when considering the mean across schools.

Table 13 shows the qualitative data for Items 13 and 14. The table shows the number of participants who conveyed each verified theme within each item. Of the 14 participants, 12 participants answered Item 13 and 12 participants answered Item 14. Eleven participants were the same between items. The strength of the theme is established by the number of participants who expressed the theme compared to other themes.

Table 13

Qualitative Themes for Survey Items 13 and 14 by Participants

Survey items	Number of participants	Percentage of participants, n=14	Verified themes
13. What are the strengths of your weekly PLT that have helped to create a collaborative culture?	2 7	14.3 50.0	Communication Actively collaborate
14. What skills do you believe your weekly PLT still needs to acquire to help create a collaborative culture?	3 2	21.4 14.3	Assessments Student learning

Items 13 and 14 inform Research Question 2. In Items 13 and 14, participants rated their weekly PLT's strengths and needs in creating a collaborative culture. Verified themes for strengths are actively collaborate with seven of 14 participants, or 50.0%, expressing the theme and communication with two of 14 participants, or 14.3%, expressing the theme. The actively collaborate theme is the greatest strength theme and the communication theme is the weakest strength theme. Because the actively collaborate theme was reported by more participants, it is the strongest theme compared to other verified themes in Item 13 and compared to all other verified themes in the research study. The Excerpts of participant responses for actively collaborate are "100% buy-in from members; we produce materials that we can use in class; we divide the work; we talk through issues together" and "We share and help one another." Excerpts of participant responses for communication are "Great communication" and "Opening the floor for everyone to share and present successful strategies or tools." Participants expressed things their PLT needs to acquire to help create a collaborative culture.

Verified themes for needs are assessments with three of 14 participants, or 21.4%, expressing the theme and student learning with two of 14 participants, or 14.3%, expressing the theme. The theme of assessments is the strongest need theme of item 14 compared to the theme of students learning based on having more participants expressing the theme. Excerpts of participant responses for assessments are “More means of summative assessment” and “More formative assessment skills.” Excerpts of participant responses for student learning are “We need to focus less on test result data and more on strategies for engagement and learning” and “sharing resources and having meaningful conversation to have ALL students reach mastery.”

In summary, Research Question 2 focused on how biology teachers perceive their PLT’s skill level in creating a collaborative culture. In general, biology teachers perceive their PLT has skills in creating a collaborative culture. This conclusion is supported in Item 12 with 73% of responses in a level of *agree* and a total mean of 4.37. They have a lower perception of skill that their PLT creates a culture of collaboration than for ensuring all students learn at high levels. This conclusion is supported by Items 12 and 9. Item 12 has 73% of responses in a level of *agree* and a total mean of 4.37 compared to Item 9 with 97% responses in a level of *agree* and a total mean of 5.08. Biology teachers believe some areas of collaboration are stronger than other areas such as their PLT collectively decided upon essential outcomes linked to state/district standards and their PLT examines the results from our common assessments. This conclusion is supported by Statements 12C and 12G. Statement 12C is “My PLT collectively decided upon essential outcomes linked to state/district standards” and Statement 12G is “My PLT examines the results from our common assessments.” Statement 12C has the highest percentage of

responses in a level of *agree* of 85.7% and the highest mean of 4.86. Statement 12G has the highest percentage of responses in a level of *agree* of 85.7% and the next highest mean of 4.71. They perceive strengths of their PLT to be active collaboration and communication with active collaboration being the greatest perceived strength. Both strengths are from verified themes with 50.0% of participants reporting and 14.3% reporting respectively. What emerged among schools was biology teacher strengths in creating common summative assessments related to the essential outcomes. This conclusion is supported in 12E with 82.3% of school means in a level of *agree*.

Biology teachers perceive the weaker areas of their PLT's skill in creating a collaborative culture to be PLTs determining common standards of mastery for proficiency of the essential outcomes and developing new teaching strategies based on the common assessment results. Supporting results are from Statements 12F and 12H. Statement 12F is "My PLT determined common standards of mastery for proficiency of the essential outcomes" and Statement 12H is "My PLT develops new teaching strategies based on the common assessment results." Statement 12F has the lowest percentage of responses in a level of *agree* at 57.2% and has the lowest mean at 4.00. Statement 12H has the next lowest percentage of responses at 64.3% and the lowest mean at 4.00. They perceive specific weaknesses to be assessment and student learning. Assessment and student learning are verified need themes for Item 12 with 21.4% of participants reporting and 14.3% of participants reporting respectively.

Research Question 3: How Do Biology Teachers Perceive Their PLT's Skill Level in Focusing on Academic Results

Items 15-17 answer Research Question 3. In Item 15, participants rated their

PLT's skills in focusing on academic results. Table 14 shows the raw data by the number and percentage of responses of the14 participants who completed Item 15. Survey Item 15 is, "Rate you weekly PLT's skills in focusing on academic results in biology." Each row adds up to 14 participants and 100%. Each Likert scale choice is followed by the weight of the response in parentheses. The mean and standard deviation are calculated for each statement.

Table 14

Results for Survey Item 15 by Participant

Strongly agree (6)	Agree (5)	Somewhat agree (4)	Somewhat disagree (3)	Disagree (2)	Strongly disagree (1)	Mean (6-point scale)	Standard deviation
N*umber and percentage of responses; n=14 participants*							
15A. My PLT team is able to honestly confront the brutal facts regarding our students' achievement data.							
35.6% 5	42.9% 6	7.1% 1	7.1% 1	7.1% 1	0.0% 0	4.93	1.16
15B. My PLT team is able to determine our students' current level of achievement.							
28.6% 4	35.6% 5	21.4% 3	7.1% 1	7.1% 1	0.0% 0	4.71	1.16
15C. My PLT team focuses on student learning rather than on teaching.							
28.6% 4	35.6% 5	7.1% 1	7.1% 3	7.1% 1	0.0% 0	4.57	1.29
15D. My PLT team discusses evidence of student academic progress at each PLT team meeting.							
14.3% 2	14.3% 2	28.6% 4	35.6% 5	7.1% 1	0.0% 0	3.93	1.16
15E. My PLT team members are able to hold each other accountable for the results that lead to continuous student improvement.							
14.3% 2	21.4% 3	50.0% 7	0.0% 0	14.3% 2	0.0% 0	4.21	1.15
Total PLT skill in focusing on academic results mean						4.47	0.36

Table 14 shows a wide range of answers for Item 15 among participants, with no participant choosing the *strongly disagree* response. As with the previous questions, the greater number of responses are a level of *agree* at 54 *agrees* of 70 responses, or 77%. The total mean of Item 15 is 4.47, which is higher than the total mean of Item 12 (4.37) but lower than the total mean of Item 9 (5.08). The total means show the strongest perception of agreeing is that teachers ensure all students learn at high levels (Item 9) followed by PLTs focusing on academic results (Item 15) with the weakest perception of agreeing being a creating a culture of collaboration (Item 12). The total mean of Item 15 shows that on average teachers reported *somewhat agree* to *agree* for their PLT's skill in focusing on academic results. Statements 15A-C are above the total mean of Item 15, and Statements 15D and 15E are below the total mean of Item 15. Statements 15A, 15B, and 15E have the same number of responses in a level of *agree* (12 *agrees* of 14 responses) even though 15A and 15B calculate to 85.6% *agrees* and 15E calculates to 85.7% *agrees*. The discrepancy of 0.1 for 85.7 is due to rounding error. Of the three statements (15A, 15B, and 15E), 15A has the highest mean at 4.93. Statement 15A is "My PLT team is able to honestly confront the brutal facts regarding our students' achievement data." The higher mean shows answers for 15A are higher on average than both 15B and 15E. The mean for is 4.71 for 15B and 4.21 for 15E. Statement 15B shows as a strength after 15A. Statement 15B is "My PLT team is able to determine our students' current level of achievement."

Statement 15D has the lowest number of responses in a level of *agree* at eight *agrees* of 14 responses, or 57.2%. Statement 15D is "My PLT team discusses evidence of student academic progress at each PLT team meeting." Statement 15D has the lowest

mean at 3.93 which shows this area to be the weakest of Item 15.

Table 15 shows the statistical analysis of Item 15. Table 15 displays the Exact test and ANOVA results for Survey Item 15. Statistically significant numbers are in bold type.

Table 15

Statistical Data for Survey Item 15

Survey item 15: Rate your weekly PLT's skill in focusing on academic results in biology.	Exact test	ANOVA
	One-sided Pr >= P	Pr > F
A. My PLT team is able to honestly confront the brutal facts regarding our students' achievement data.	0.3953	0.6010
B. My PLT team is able to determine our students' current level of achievement.	0.2120	0.4853
C. My PLT team focuses on student learning rather than on teaching.	0.2120	0.6219
D. My PLT team discusses evidence of student academic progress at each PLT team meeting.	**0.0065**	0.8856
E. My PLT team members are able to hold each other accountable for the results that lead to continuous student improvement.	**0.0287**	0.5384

The Exact test shows significance for 15D and 15E. Statement 15D is "My PLT team discusses evidence of student academic progress at each PLT team meeting" and 15E is "My PLT team members are able to hold each other accountable for the results that lead to continuous student improvement." The ANOVA is not significant for any statement in Item 15. I did not disaggregate data in Item 15 by the number of schools because no statement showed a significant ANOVA.

Items 16 and 17 inform Research Question 3. Table 16 shows the qualitative data for Items 16 and 17. The table shows verified themes per item and includes the number of participants who expressed the theme. Eleven of the 14 participants answered Items 16 and 17. The strength of the theme is established by the number of participants who

expressed the theme relative to other themes.

Table 16

Qualitative Data Themes for Survey Items 16 and 17 by Participant

	Number of participants	Percentage of participants; n=14	Verified themes
16. What are the strengths of your weekly PLT that have helped the PLT focus on academic results?	4	28.6	Use of data
	3	21.4	Cooperation/Collaboration
17. What skills do you believe your weekly PLT still needs to acquire to assist in focusing on academic results?	2	14.3	Forming/Sharing results of common assessments
	2	14.3	Supporting student subgroups

In Items 16 and 17, participants rated their weekly PLT's strengths and needs focusing on academic results. The verified themes for strengths are use of data expressed by 28.6% of participants and cooperation/collaboration expressed by 21.5%. The use of data theme is the strongest verified strength theme for Item 16 because it was reported by more participants compared to the other theme. Excerpts of participant responses for use of data are "Discussions about data" and "we constantly are looking at our assessment data and adjusting our teaching and pacing accordingly. We base what we do on what our kids need as much as we can." Excerpts of participant responses for cooperation/collaboration are "ability to speak openly and be able to collaborate effectively" and "We have worked together a long time and have tried to take small parts of the our academic progress as a target each year."

Participants expressed their PLT's needs in focusing on academic results. Verified themes for areas of need are forming and sharing results of common assessments expressed by 14.3% of participants and supporting student subgroups expressed by 14.3%. The themes have equal strength because they were reported by the same number of participants. Both need themes were expressed in previous items. Participants expressed the need for support with assessments in Item 11 of Research Question 2. Participants expressed the need to support subgroups in Item 4 of Research Question 1 as the need theme for differentiation for different populations. Excerpts of participant responses for forming/sharing results of common assessments are "Forming common assessments" and "need to share results of common assessments." Excerpts of participant responses for supporting student subgroups are "working to better accommodate our EL [English Learners] and SWD [Students with Disabilities] populations" and "we asked for support on gifted learners."

In summary, Research Question 3 focused on how biology teachers perceive their PLT's skill level in focusing on academic results. Biology teachers perceive their PLT has skill in focusing on academic results. Support for this conclusion is in Item 15 with 77% of responses in a level of *agree* and a total mean of 4.47. Biology teachers have a higher perception of skill in focusing on academic results than in creating a culture of collaboration. Support for this conclusion is in Item 15 at 77% of responses in a level of *agree* and a total mean of 4.47 along with Item 12 at 72% of responses in a level of *agree* and a total mean of 4.37. Biology teachers have a lower perception of skill in focusing on academic results than in ensuring all students learn at high levels. Supporting results are the comparison of Item 15 to Item 9. Item 9 has 98% of responses in a level of *agree* and

at total mean of 5.08. Biology teachers perceive their PLT's skills are more developed in the ability to honestly confront the brutal facts regarding student achievement data and in determining student current levels of achievement. Supporting results are Statement 15A at 85.6% of responses in a level of *agree* and the highest mean of 4.93 along with Statement 15B at 85.6% of responses in a level of *agree* and the next highest mean of 4.71. Biology teachers are aware of their strengths in the use of data and in cooperation and collaboration within their PLT. Supporting results are verified strength themes with 28.6% of participants reporting and 21.5% of participants reporting respectively.

Biology teachers perceive the weaker areas of their PLTs focusing on academic results to be the PLT team discussing evidence of student academic progress at each PLT team meeting. Supporting results are from Statement 15D with the lowest percentage responses with a level of *agree* at 57.2% and the lowest mean of 3.93. Biology teachers recognize specific weaknesses to be forming and sharing results of common assessments and supporting student subgroups. Supporting results are the two verified need themes with 14.3% of participants reporting for each theme.

Research Question 4: To What Extent Do Biology Teachers Believe Their Teaching Practices Have Been Impacted as a Result of Working in PLTs?

Items 18-20 answer Research Question 4. In Item 18, participants rated the level of impact that working in PLTs had on their teaching practices. In Item 19, participants reported the type of impact as *positive only*, *negative only*, or *positive and negative impact*. Table 17 shows the responses for Survey Items 18 and 19 along with the number of participants who chose each response, the weight of each response, and the mean and standard deviation for Items 18 and 19.

Table 17

Results for Survey Items 18 and 19 by Participant

Survey item 18: Rate the impact of your participation in your weekly PLT meeting on your teaching practices. (weight on Likert scale)	Number of participants	Percentage of participants who responding to items 18 and 19; n=14	Percentage of participants who reported an impact; n=12	Survey item 19: IF your teaching practices were impacted by your participation in your weekly PLT meeting, describe the type of impact. (weight on Likert scale)
Not impacted (1)	2	14.3	0	0
Slightly impacted (2)	1	7.2	8.3	Positive impact only (3)
	2	14.3	16.7	Positive & negative impact (2)
Moderately impacted (3)	5	35.7	41.7	Positive impact only (3)
	1	7.2	8.3	Positive & negative impact (2)
Very impacted (4)	1	7.2	8.3	Positive impact only (3)
Extremely impacted (5)	2	14.3	16.7	Positive impact only (3)
Mean for rating of impact=2.86				Mean for type of impact=2.75
Standard deviation=1.19				Standard deviation=0.43

For Item 18, two participants, or 14.3%, chose *not impacted*, leaving 12 participants, or 85.7%, who reported an impact. The mean for the rating of impact is 2.86, meaning the average answer of the rating of impact is between *slightly impacted* and *moderately impacted* and leans more toward *moderately impacted*. The *moderately impacted* choice has the most responses at 42.9%, and the *very impacted* choice has the fewest responses at 7.1%.

In Item 19, nine participants reported the type of impact as *positive only*. The percentage is 75% (nine of 12) of participants who reported an impact and 64.3% (nine of 14) of participants who completed this survey item. The three remaining participants

chose *positive and negative impact*, which is 25.0% of participants who reported impact and 21.4% of participants who completed Items 18 and 19. In Item 19, no participants reported the impact as *negative only*. The mean of the type of impact is 2.75, meaning the average response is between *positive impact only* and *positive and negative impact* but leans toward *positive impact only*. The combination of answers between Items 18 and 19 with the greatest number of responses is *moderately impacted* with *positive only impact*. This combination was reported by five of 12 participants, or 41.7%, who reported impact and by five of 14 participants, or 35.7%, who completed Items 18 and 19.

Table 18 shows the statistical data for Survey Items 18 and 19. Statistically significant numbers are in bold type.

Table 18

Statistical Data for Survey Items 18 and 19

Survey items	Exact Test	ANOVA
	One-sided Pr >= P	Pr > F
Survey item 18: Rate the impact of your participation in your weekly PLT meeting on your teaching practices.	**0.0065**	0.9678
Survey item 19: IF your teaching practices were impacted by your participation in your weekly PLT meeting, describe the type of impact.	0.0730	0.4121

In Table 18, Item 18 shows significance on the Exact test. Neither item shows significance for the ANOVA. I did not disaggregate Items 18 and 19 by the number of schools because neither item showed significance for the ANOVA.

Item 20 informs Research Question 4. Table 19 shows the themes for Item 20 according to the rating of impact in Item 18. The table includes the number of participants who communicated the theme.

Table 19

Qualitative Data Themes for Survey Item 20 by Rating of Impact in Survey Item 18 by Participant

Rate the impact of your participation in your weekly PLT meeting on your teaching practices.	Number of Participants	Percentage of participants who completed items 18 and 19; n=14	Percentage of participants who reported impact; n=12	Verified themes of survey item 20 Explain why you choose that degree of impact in item18.
Survey Item 18				
Not impacted	2	14.2	0.0	No benefit/Lack of growth and improvement in teaching practices
Impacted [Slightly, Moderately, Very, & Extremely]	4 2	28.6 14.2	33.3 16.7	Data Ideas

In Table 19, I grouped themes from Item 20 by the impact on teaching practices. In Table 19, the two participants who reported no impact by working in PLTs had the theme of no benefit/lack of growth and improvement in teaching practices. The two participants made up 14.2% of the 14 participants who completed the items. The 12 participants who reported impact had themes of data (four of 14 participants, 28.6%) and ideas (two of 14 participants, 14.2%). The data theme is the strongest theme for item 18 because it was expressed by the most participants. The ideas and no benefit/lack of growth and improvement in teaching practices theme had equal strength because they were expressed by the same number of participants. Excerpts of participant responses for no benefit/lack of growth and improvement in teaching practices are “PLT did not benefit me” and “Our PLT had no plan or follow-up which lead to no growth in teaching practices.” Excerpts of participant responses for the data theme are “We look at areas that are weak in the data presented in our PLT” and “We have created good, mostly, common assessments that seem to accurately rate students' mastery of content and achievement.” Excerpts of participant responses for ideas are “I feel it is helpful to bounce ideas and

thoughts of another" and "I often get good ideas and materials from my biology teacher colleagues."

In Table 20, I show the verified themes in Item 20 by the type of impact in Item 19. The table includes the number of participants who conveyed each theme. Eleven of the 14 participants answered Item 20.

Table 20

Qualitative Data Themes for Survey Item 20 by Type of Impact in Survey Item 19 by Participant

Survey item 19 If your teaching practices were impacted by your participation in your weekly PLT meeting, describe the type of impact.	Number of participants	Percentage of participants who completed items 18 and 19; n=14	Percentage of participants who reported impact; n=12	Percentage of participants who reported positive only impact; n=9	Verified themes of survey item 20 Explain why you choose that degree of impact.
Positive impact	3	21.4	25.0	33.3	Data
only	2	14.3	16.7	22.2	Ideas

Table 20 shows five of the 14 participants, or 35.7%, reported *positive impact only*. The data theme was expressed by a total of 21.4% of participants who completed Items 18 and 19, 25.0% of participants who reported impact, and 33.3% of participants who reported positive only impact. The data theme is the strongest theme for item 19 because more people expressed the theme. The idea theme is the weakest theme and was expressed by 14.3% of participants who completed Items 18 and 19, 16.7% of participants who reported impact, and 22.2% of participants who reported positive only impact.

In summary, Research Question 4 focused on the extent to which biology teachers believe their teaching practices have been impacted as a result of working in PLTs. The majority of biology teachers believe their teaching practices have been impacted as a

result of working in PLTs. Supporting results are from Item 18 with 85.7% of participants reporting impact and a mean of 2.86. The greatest percentage of teachers recognize working in PLT has a moderate impact on their teaching practices. Supporting results are from Item 19 with 42.9% of participants reporting *moderate impact*. Biology teachers perceive the impact of PLTs to be positive at least in part as no participant reported solely *negative impact* from PLTs. Most biology teachers perceive the impact to be all positive, while some biology teachers perceive positive and negative effects. Supporting results are in Item 19 with 64.3% of participants choosing *positive only impact* and a mean of 2.75 along with 21.4% of participants choosing *positive and negative impact.* Biology teachers most commonly report moderate impact that is solely positive. Supporting results are from Items 18 and 19 with 35.7% of participants reporting. When biology teachers consider the rating and type of impact of working in PLTs on their teaching practices, they express themes of data and ideas. Supporting results are from Item 20 with 28.6% of participants reporting data themes and 14.2% of participants reporting idea themes. Some biology teachers perceive that PLTs do not impact their teaching practices, citing no benefit and lack of growth and improvement from working in PLTs. Supporting results are from Item 20 with 14.2% of participants reporting no benefit and lack of growth and improvement in teaching practices.

Research Question 5: What is the Association Between Teacher Perceptions of PLTs and Student Achievement in Biology?

The statistically significant Exact test results and data reported by GLP ranges informed Research Question 5. Items 12, 15, and 18 had at least one statistically significant Exact test score. Table 21 shows the statements with statistically significant

Exact test results from Tables 11, 15, and 18. Statistically significant numbers are in bold type.

Table 21

Statements and Item showing Statistical Significance for the Exact Test

Survey statements and item with significant Exact test results	Exact Test	ANOVA
	One-sided Pr >= P	Pr > F
Item 12: Rate your weekly PLT's skill in creating a collaborative culture.		
12A My PLT clarified roles and responsibilities.	**0.0287**	0.3234
12B My PLT clarified norms.	**0.0287**	0.7935
12D My PLT created common formative assessments related to the essential outcomes.	**0.0065**	0.7369
12E My PLT created common summative assessments related to the essential outcomes.	**0.0287**	**0.0538**
Item 15: Rate you weekly PLT's skills in focusing on academic results in biology.		
15D My PLT team discusses evidence of student academic progress at each PLT team meeting.	**0.0065**	0.8856
15E My PLT team members are able to hold each other accountable for the results that lead to continuous student improvement.	**0.0287**	0.5384
Item 18: Rate the impact of your participation in your weekly PLT meeting on your teaching practices.	**0.0065**	0.9678

Items 9 and 19 are not included in Table 21 because no statements showed significance for the Exact test. Statements 12A, 12B, 12E, and 15E have a result of 0.0287. Statements 12D, 15D, and Item 18 have a more significant result of 0.0065.

Table 22 shows the total mean and total range of Likert scale scores for schools in Items 12A, 12B, 12D, and 12E. The schools are grouped by GLP percentage ranges to maintain anonymity. The low GLP percentage range is <5-33% and includes four schools. The medium GLP percentage range is 45-65% and includes three schools. The high GLP percentage range is 80->95% and includes four schools. I reported data

disaggregated by school for Statements 12A, 12B, 12D, and 12E because they showed statistical significance for the Exact test. As in Roberts's (2010) study, the mean was used to express the central tendency of results to Likert scale questions. To add more meaning to the mean, I provided the range of the mean scores. The range provided a "measure of spread" (Lund Research Ltd, 2018b, para. 1) to "describe the variability in a sample or population" (Lund Research Ltd, 2018b, para. 1). "A measure of spread gives us an idea of how well the mean, for example, represents the data" (Lund Research Ltd, 2018b, para. 2). Targeted responses had lower ranges as they indicate close data points (Lund Research Ltd, 2018b) and consistency in responses. The total mean was calculated using the schools within each GLP range. Means and ranges are arranged from the greatest to the smallest value. Total mean scores with the smallest ranges are in bold type. The smallest ranges are in bold type.

Table 22

Total Mean and Total Range of Likert Scores for Schools Grouped by GLP Percentage Ranges for 12A, 12B, 12D, and 12E

Statement	Total Likert mean of schools grouped by GLP range (Med=medium)	Total Likert range of schools grouped by GLP range
12A My PLT clarified roles and responsibilities	High (4.88) Low (4.50) Med (4.17)	Med (4.5) Low (3.0) High (2.5)
12B My PLT clarified norms.	**High (5.38)** Low (4.75) Med (3.83)	Med (4.5) Low (2.0) **High (1.5)**
12D My PLT created common formative assessments related to the essential outcomes.	Med (4.83) High (4.25) Low (3.75)	High (3.5) Med(3.0) Low (3.0)
12E My PLT created common summative assessments related to the essential outcomes.	Low (4.76) **Med (4.67)** High (4.25)	Low (4.0) High (3.5) **Med (1.0)**

In Item 12, participants rated their weekly PLT's skill in creating a collaborative culture. Participant results for statement 12B show the highest total mean (5.38) and the smallest total range (1.5) for the high GLP range schools. Statement 12B is "My PLT clarified norms." The high GLP range schools show a small total range (1.5) indicating the total mean (5.38) is representative of the biology teachers who reported from a high GLP school. A total mean of 5.38 falls between *strongly agree* and *agree* on the Likert scale.

For 12E, the medium GLP range schools show a small total range (1.0) indicating the total mean of 4.67 is representative of the biology teachers who reported from a medium GLP school. Statement 12E is "My PLT created common summative

assessments related to the essential outcomes." A total mean of 4.67 falls between *agree* and *somewhat agree* on the Likert scale.

Table 23 shows disaggregated data for Statements 15D and 15E. The table displays the total means and total range of schools. Schools are grouped by their GLP percentage ranges. Total mean scores with smallest ranges are in bold type. The smallest ranges are in bold type.

Table 23

Total Mean and Total Range of Likert Scores for Schools by GLP Percentage Ranges for 15D, and 15E

Item	Total Likert mean of schools by GLP range	Total Likert range of schools by GLP range
15D	**Med (4.00)**	High (3.0)
My PLT team discusses evidence of student academic progress at each PLT team meeting	Low (3.75) High (4.25)	Low (2.0) **Med (0.0)**
15E	High (5.13)	Low (3.0)
My PLT team members are able to hold each other accountable for the results that lead to continuous student improvement.	Low (3.75) **Med (3.67)**	High (2.0) **Med (1.0)**

In Item 15, participants rated their weekly PLT's skills in focusing on academic results in biology. Table 23 shows participant responses for statement 15D resulting in the highest total mean (4.00) and the smallest total range (0.0) for the medium GLP range schools. The medium GLP range schools show a small total range indicating the total mean is representative of the biology teachers who reported from a medium GLP range school. A total mean of 4.00 falls directly on *agree* on the Likert scale. Statement 15E shows the lowest total mean (3.67) and the smallest total range (1.0) for the medium GLP range schools. The medium GLP range schools show a small total range indicating the total mean is representative of the biology teachers who reported from a medium GLP range school. A total mean of 3.67 falls between *somewhat agree* and *somewhat disagree* on the Likert scale indicating biology teachers in medium GLP range schools are not definite if their PLT members are or are not able to hold each other accountable for the results that lead to continuous student improvement.

I reported disaggregated data for Item 18 in Table 24. The table shows the total

mean and total range for schools in each GLP range. The total mean scores with smallest ranges are in bold type. The smallest ranges are in bold type.

Table 24

Total Mean and Total Range of Likert Scores for Schools by GLP Percentage Ranges for Item 18.

Item	Total Likert mean of schools by GLP range	Total Likert range of schools by GLP range
18 Rate the impact of your participation in your weekly PLT meeting on your teaching practices.	Med (3.33) High (3.25) **Low (2.75)**	Med (4.0) High (2.5) **Low (1.0)**

For the low GLP range schools, Item 18 has the lowest total mean (2.75) and the smallest total range (1.0). The low GLP schools have a small total range showing the total mean for Item 18 is representative of teachers reporting from the low GLP range schools. The total mean for the low GLP range schools is similar to the total mean for Item 18 (2.86) and falls between slightly impacted and moderately impacted.

In summary, Research Question 5 focused on the association between teacher perceptions of PLTs and student achievement in biology. Biology teachers in schools with a high GLP percentage range perceive their PLT clarifies norms. Supporting results are from Statement 12B with a total mean of 5.3 and a total range of 1.5. Statement 12B is “PLT clarifies norms.” Biology teachers in schools with a medium GLP percentage range perceive their PLT creates common summative assessments related to the essential outcomes. Supporting results are from Statement 12E with a total mean of 4.7 and total range of 1.0. Medium GLP school biology PLTs also discuss evidence of student academic progress at each PLT team meeting. Supporting results are from Statement 15D

with a total mean of 4.0 and total range of 0. Biology teachers in schools with a medium GLP percentage range are not definite if their members are or are not able to hold each other accountable for the results that lead to continuous student improvement. Supporting results are from Statement 15E with a total mean of 3.7 and total range of 1.0. Teachers in low GLP percentage range schools report that PLTs have a less than moderate impact on teaching practices. Supporting results are from item 18 with a total mean of 2.8 and a total range of 1.0.

Comparison of Results to Roberts's (2010) Study

Roberts's (2010) results overlap with some results from the research study. Roberts used a 5-point Likert scale and had 247 participants of the 682 teachers who were eligible to participate. I used a 6-point Likert scale and had 16 participants of the 45 teachers who were eligible to participate. Table 25 shows the overlap of the results.

Table 25

Comparison of Results with Roberts's (2010) Results

Similarities by DuFour's big ideas	Roberts (2010) Used a 5-point Likert scale	Dawkins (2020) Used a 6-point Likert scale
Perception of personal skill level in ensuring that all students learn at high levels		
Highest mean of all items	4.38	5.08
Highest statement mean was A "I know the essential objectives all students need to learn in my classroom."	4.73	5.57
Statement means for D, E, and F were below the total mean for the item		
D "My personal response for students who struggle is supported through research-based intervention."	D (4.18) [Total item mean is 4.38]	D (4.86) [Total item mean is 5.08]
E "My personal interventions require students to devote extra time to skills to assure mastery."	E (4.31)	E (5.07)
F "I provide enrichment for those students who have already mastered the content."	F (4.11)	F (4.93)
Perception of PLTs creating a collaborative culture		
Highest statement mean was C "My PLT Team collectively decides upon essential outcomes linked to state/district standards."	4.50	4.86
Statement G was above the total mean for the item "My PLT team examines the results from our common assessments."	G (4.36) [Total item mean is 4.28]	G (4.71) [Total item mean is 4.37]
Statement H was reported as a need and was below the total mean for the item. "My PLT team develops new teaching strategies based on the common assessment results."	H (4.15)	H (4.00)
A theme for strengths is Collaboration		
Perception of PLTs' skill in focusing on academic results.		
Highest statement means for A and B		
A "My PLT Team is able to honestly confront the brutal facts regarding our students' achievement data."	A (4.39)	A (4.93)
B "My PLT Team is able to determine our students' current level of achievement."	B (4.46)	B (4.71)

(continued)

Similarities by DuFour's big ideas	Roberts (2010) Used a 5-point Likert scale	Dawkins (2020) Used a 6-point Likert scale
Statement D showed as a need		
D "My PLT Team discusses evidence of student progress at each PLT Team meeting."	D (4.22)	D (3.93)
Statement means of D and E were below the total mean for the item.		
D "My PLT Team discusses evidence of student progress at each PLT Team meeting."	D (4.22) [Total item mean is 4.24]	D (3.93) [Total item mean is 4.47]
E "My PLT team members are able to hold each other accountable for the result that lead to continuous student improvement."	E (3.96)	E (4.21)
Theme for strengths were collaboration and use of data.		

I compared results of the research study and Roberts's (2010) research study and grouped results by the research questions. In the ensuring students learn items on the survey, participants rated themselves highly on their knowledge of essential objectives that all students need to learn. Participants gave lower ratings when asked about servicing students who struggle and students who excel. In the creating a collaborative culture items, examining results of common assessments was rated above the average, but basing new teaching strategies on those results was a need. In the focusing on academic results items, participants determine student achievement levels but do not discuss student progress at each PLT meeting. The results for Statement D could be affected by the use of the word each, because it is so specific.

Summary

In Chapter 4, I presented the findings in the research study on the perceived effects of work in PLTs on teacher practices and student achievement in biology. Chapter 4 provided the quantitative and qualitative data from the research study and answered the

research questions. The data included raw data, statistical analysis, and verified qualitative themes on the structure and function of biology PLTs. Chapter 4 also included a comparison of Roberts's (2010) results with the results of the research study.

Chapter 5 contains a discussion of research study results, limitations, and recommendations for future studies. The discussion explores implications from data results and Roberts's (2010) research study. Implications are inferences that can be drawn from results and applied in a general sense. Limitations explain inherent restrictions generalizing results. The recommendations include ways to extend the research study with changes in participants, length of study, and achievement data sources.

Chapter 5: Conclusion

Overview

The research study provided information on the perceived impact of working in PLTs on academic achievement and teaching practices in biology. Achievement in biology is crucial to the success and competitive edge of the nation as it nurtures and develops students in life science. Students learn analytical thinking and interconnectedness of organisms and the environment which carries over and supports other disciplines and creates a platform to promote jobs that help sustain life on Earth. I specifically considered PLTs to understand their perceived effect on teacher practices and the achievement of students.

This research study is a replication of Roberts's (2010) study by extension. The study is centered around DuFour's (2004) three big ideas about PLTs: ensuring all students learn at high levels, creating a collaborative culture, and focusing on academic results. The central question is, "How has student achievement been impacted when educators worked in PLTs?" The supporting research questions are

1. How do biology teachers perceive their personal skill level in assuring that all students learn at high levels?
2. How do biology teachers perceive their PLT's skill level in creating a culture of collaboration?
3. How do biology teachers perceive their PLT's skill level in focusing on academic results?
4. To what extent do biology teachers believe their teaching practices have been impacted as a result of working in PLTs?

5. What is the association between teacher perceptions of PLTs and student achievement in biology?

The participants were teachers who taught biology in the previous school year. Participants accessed the survey in SurveyMonkey answering quantitative and qualitative questions. I used a modified survey from Roberts's (2010) study for the host district. The quantitative data came from items with Likert scale questions using *strongly agree, agree, somewhat agree, somewhat disagree, disagree,* and *strongly disagree*. Each item Likert scale question had one or two accompanying qualitative questions. For Research Questions 1-3, I analyzed quantitative data using total Likert mean per item, Likert mean per statement (for participants and schools), percentage of responses in a level of *agree* (*somewhat agree, agree,* or *strongly agree*), and a one-way ANOVA. Themes and percentage of participants were used to analyze qualitative data. For Research Question 4, I analyzed the data using total Likert mean per item (for rating and types of impact), percentage of participants, and a one-way ANOVA. Themes and percentage of participants were used to analyze qualitative data. For Research Question 5, I analyzed the data using Fisher's Exact test, GLP percentages per school reported by ranges, total Likert response mean per GLP range, and total Likert response range per GLP range. I grouped schools into GLP percentage ranges—low GLP range, medium GLP range, and high GLP range—to report data for Research Question 5.

The findings for Research Question 1 show biology teachers perceive they have a high skill level in assuring that all students learn at high levels. Biology teachers perceive they know essential objectives that students need to learn in their classrooms. Both findings are consistent with Roberts's (2010) results. Participants showed strengths in

applying the concepts, recognizing students are on different academic levels, and forming relationships with their students. Biology teachers had relatively weaker scores for having research-based intervention responses for students who struggle, providing enrichment for students who have already mastered the content, and meeting needs of different learners. Biology teachers reported the need for student accountability and learner buy-in and improvements in labs.

The findings for Research Question 2 show biology teachers perceive their PLT has skills in creating a collaborative culture. Biology teachers believe strong areas are their PLT collectively deciding upon essential outcomes linked to state/district standards and examining results from common assessments. Both findings are consistent with Roberts's (2010) findings. Other strengths perceived are active collaboration, communication, and creating common summative assessments related to the essential outcomes. The theme of collaboration is consistent with Roberts's results. Biology teachers perceive a weakness to be developing new teaching strategies based on the common assessment results which is consistent with Roberts's findings. Biology teachers perceive the weak areas to be their PLT determining common standards of mastery for proficiency of the essential outcomes, assessments, and student learning.

The findings for Research Question 3 show biology teachers perceive their PLT has skill in focusing on academic results. Biology teachers perceive areas of strength are their PLT's ability to honestly confront the brutal facts regarding student achievement data and determining student current levels of achievement. These findings are consistent with Roberts's (2010) findings. Other perceived strengths are cooperation and collaboration within the PLT. As in the research study, the theme of collaboration

emerged in Roberts's findings. Perceived weaknesses are the PLT team discussing evidence of student academic progress at each PLT team meeting, forming and sharing results of common assessments, and supporting student subgroups.

The findings for Research Question 4 show the majority of biology teachers believe their teaching practices have been impacted in a positive way as a result of working in PLTs. Some biology teachers perceive there are negative impacts along with the positive impact. Overall, biology teachers most often report working in PLTs has a positive and moderate impact on their teaching practices. Biology teachers express themes of data and ideas when asked about the impact of PLTs on their teaching practices. Some biology teachers perceive that PLTs do not impact their teaching practices, PLTs are of no benefit, and PLTs have caused a lack of growth and improvement in teaching practices.

The findings for Research Question 5 show similarities in biology teacher responses for schools within the same GLP percentage range. Biology teachers in the high GLP percentage range schools perceive their PLT clarifies norms. In schools with a medium GLP percentage range, biology teachers perceive their PLT creates common summative assessments related to the essential outcomes and discusses evidence of student academic progress at each PLT team meeting. Biology teachers in schools with a medium GLP percentage range are unsure that members hold each other accountable for the results that lead to continuous student improvement. Biology teachers in low GLP percentage range schools report PLTs have a less than moderate impact on teaching practices.

Discussion

Results and themes in the research study consistent with Roberts's (2010) results support the generalizability of Roberts's findings. These results and themes show that portions of Roberts's results are consistent across various factors including different populations (midwestern K-12 versus North Carolina 9-12 students and teachers), different disciplines (English/language arts and math versus biology), and different sources of achievement data (local comprehension and skill test scores versus state GLP percentages). These shared results and themes span across DuFour's (2004) three big ideas.

Participants in both studies perceive strength in ensuring all students learn at high levels. The strength of knowing the essential objectives evident in both studies reveals a confidence in content knowledge. Their perceived strength to use data from common assessments and determine the skill level of students shows the PLTs in both studies focus to stay aware of student progress. Both studies show a need to use that same data to develop new teaching strategies and to discuss student progress at each PLT meeting. Participants perceived skill in facing reality in achievement data, deciding on essential outcomes based on state and district standards, and being transparent to take responsibility for student outcomes. Across big ideas, participants expressed strengths in collaborating with peers to support student progress and each other. In the bigger picture, the results and themes common to both studies reiterate data access and use, awareness of student progress, and alignment to standards and essential objectives are part of the foundation for PLT functioning (DuFour et al., 2010; Graham & Ferriter, 2010). Though the research study supports certain aspects of Roberts's (2010) study, the research study

shows differences as well.

A marked difference between the findings of Roberts's (2010) study and this research study is the finding of statistically significant associations between teacher perceptions of skills in PLTs and student achievement in this research study. Among the associations is data that suggests there are aspects that are similar among PLTs within schools of a common GLP percentage range. Schools that have high GLP percentages reported greater skill levels in clarifying PLT norms which suggests educational institutions and school leaders can build productive biology PLTs with consistency and order in PLT structure. Developing cohesion among biology PLT members around defined PLT processes and structure yields results in greater student achievement as they methodically analyze data, plan, enact, and reflect (Graham & Ferriter, 2010; Reitz, 2018). Medium GLP percentage schools showed perceived strengths in creating common summative assessments related to essential outcomes and discussing evidence of student academic progress at each PLT meeting. Training PLT members how to create relevant data sources that capture all elements of the culminating concepts and how to regularly use the data to track student progress sets up biology teachers to support their students' academic performance (Frizziellie et al., 2016; Gerzon & Jones, 2020). As institutions and leaders promote these PLT skills, they must also address areas that tend to be weaknesses in biology PLTs such as holding each other accountable for the results that lead to continuous student improvement which was evident for Medium GLP percentage schools. From the onset of building and improving biology PLTs, leaders must establish accountability for all PLT members. Accountability adds to the progress of students as it orients the work and climate within PLTs, so it is impactful for all biology teachers. As

institutions and leaders equip their biology PLTs to function effectively, student achievement is strengthened and achievement gaps among subgroups are addressed (Frizziellie et al., 2016; Gray, 2018). Attention to these factors of clarifying norms, creating common assessments, and discussing evidence of student academic progress within the Low GLP percentage schools could be factors that increase the positive impact on teaching practices on biology teachers within the school. The result could be impact that exceeds moderate impact as opposed to the reported less than moderate impact. Improvement and development of biology PLTs rest in the consistency, focus, and intentionality of its members and supporters (Graham & Ferriter, 2010; Squires & Milburn, 2018; Vescio et al., 2007). Findings in the study suggest defined PLT processes such as clarifying norms, discussing student progress data, and creating common summative assessments aligned to essential outcomes can support teaching practices to yield greater student achievement in biology.

Based on the findings within the host district, more specific recommendations can be made related to supporting effective functioning of PLTs that show an association to increased biology achievement. To increase the benefit and promote improvement in teaching practices, PLTs can incorporate the use of resources to increase consistency, focus, and intentionality. This recommendation is based on the theme from participants who expressed that PLT does not impact their teaching. Comments from participants were “PLT did not benefit me” and “Our PLT had no plan or follow-up which lead to no growth in teaching practices.” PLTs can use resources like agendas, checklists, and PLT meeting templates. Through the use of these resources, PLTs can plan meetings to ensure they focus on specific student needs and strengths and clarify norms. PLTs can use

agendas and templates to track progress and to focus feedback. A specific tool to track PLT work will support the inclusion of items currently missing in meetings. Graham and Ferriter (2010) developed such a tool with support materials. Graham and Ferriter's (2010) team agenda template helps PLT members plan meetings around their focus and track progress. In the template, PLT members consider the relevance of their topics to school goals, timeframe to complete actions, indicators of progress on topics, and rating of the PLT meeting's function. To address more identified needs and support functions identified in Medium and High GLP percentage schools, biology PLTs could add other sections to the PLT agenda, checklist, or template. Other sections could be added for reflecting on the use and effectiveness of differentiation techniques, focusing on common assessments, and reviewing clarified norms. Using the data and personal reflections from the agenda, PLT members can track their own progress (Dalporto, 2019; Gerzon & Jones, 2020).

For this district specifically, data analysis points to the need for more training and time to practice differentiation. Teachers in the study expressed a desire for professional learning to support academic success for students who are struggling, students who were advanced, and various student subgroups. Professional learning focused on students supports student learning (Schachter et al., 2019; Themat & Ver Loren, 2019). Comments made by participants about the needs of PLT members are "Continue getting better differentiating, especially for our growing EL population," "More formative assessment skills/differentiation approaches for hard-to-reach level students," "Extension activities for advanced learners," "How to effectively differentiate to students of all levels," and "working to better accommodate our EL and SWD populations." Subgroups included

students with disabilities, English learners, and academically gifted students. Identified needs from this research study can be aligned with resources to meet the needs. Resources include targeted training, identified strengths that can support the need, necessary staff support, and training materials. These resources can be incorporated into PLT meeting time. Based on findings from this study, biology teachers would benefit from professional learning on differentiation techniques to support struggling and advanced learners. Specific strategies that would serve all students as well as identified student needs are cooperative learning and culturally responsive teaching. In cooperative learning, students work in pairs or teams (Raviv et al., 2019). The work is structured to promote acquisition or practice of content through communications and sharing of the workload with group members. In culturally responsive teaching, teachers use the students' culture to teach the content (Laughter & Adams, 2012). Teachers incorporate aspects of students' culture such as skillsets and knowledge bases to drive lessons and student feedback. These techniques increase peer learning and student interaction with content (Byrd, 2016; Genc, 2016; Laughter & Adams, 2012; Raviv et al., 2019). District instructional coaches and school-based educators have the knowledge base to support PLT members in learning and improving these strategies.

Another specific recommendation is for PLT members and PLT supporting staff to be vocal about instructional needs and actively seek resources and personnel needed to meet the needs of students and teachers (Graham & Ferriter, 2010, Gray, 2018). In comments from participants for need themes, participants expressed the desire to increase their knowledge base. Some comments were "How to effectively differentiate to students of all levels." and "How to get more buy-in from unmotivated learners." The host district

has various types of instructional coaches and resources available to address needs of biology teachers. Biology teachers need continued practice, support, and time to become proficient in the strategies and resources. Each PLT should discuss the right timing of training and sequence of training to address the different needs at different schools. It would be overwhelming for the PLT to begin to address all needs at the same time. PLT members need time to learn, apply, critique, and adjust newly learned strategies and resources to become proficient and comfortable using the strategies. Change takes time and effort. Using their strengths in collaboration and cooperation, PLTs can work through the implementation dips and learning curves to provide needed support for teachers and ultimately yield improved student academic success.

Limitations

The research study is limited by its design. Limitations are weaknesses in the study that might limit the generalization of the results. The study is limited to one public school district in North Carolina. Survey data came from the perceptions of teachers who taught a biology course in the 2018-2019 school year. The sample size is small. The study considers only GLP percentages reported in ranges as a measure of achievement.

For the research study, I am an internal and external evaluator. I was an internal evaluator because I am an employee within the district. I was an external evaluator because I was not a participant in the study. I might have been biased based on my employment in the CR district and based on my experience as a biology teacher. I limited possible bias by using statistical analysis and by theme verification from independent researchers who did not qualify to be a participant.

The findings are not generalizable to PLTs for teachers of all subjects in all school

districts and for biology teachers outside of the host district. Teachers and PLTs of biology courses may be more developed and have more support because state test achievement is a component used to evaluate the effectiveness of the school and district on a state report card. Teachers may avoid teaching biology courses because of the added pressure of high stakes testing and of impacting the school and district state report card grades. Because teachers may avoid the class, there may be other factors that are similar about teachers who do not avoid the class. All school districts may not mandate weekly PLT time and PLT support found in the CR district.

Recommendations for Future Research Studies

Future research studies can replicate this research study and alter the participants. Researchers can include PLTs for all high school teachers who teach state-tested courses, all high school science teachers, all middle school science teachers, or all middle and high school science teachers. Using these participants, researchers can determine if the results of this study carry over to other science courses and grades. This replication may also provide a larger population to study. Future researchers could use a larger sample size. I would be interested to know if the larger sample size would still show the statistical significance in the same areas and if schools were still ambiguous about whether PLT members were being held accountable.

Future researchers can replicate the study and analyze data by standards. Participants can provide scores from their school or personal goal summary by content objectives. The researcher would align the survey results to the goal summary data to see if there is statistical significance. The results from this study could show teacher perspectives compared to specific standards and objectives. The results can give another

angle to understand the association between teacher perspectives and student achievement.

Future researchers can replicate the research study in various school districts or school types. School districts across the world can adapt the study to their regions to understand the perceived effect of adult educational teams. Researchers can use participants in science PLTs from public schools, private schools, or charter schools. Researchers can compare the results among the three types of schools to understand perspectives across school types.

Future researchers can replicate the research study using a different or an additional data source. Researchers can ask teachers to report Education Value-Added Assessment System (EVAAS) data or quarterly assessment data anonymously instead of using state test scores. Researchers can compare the survey responses about PLTs against reported data. This research study would be specific to each member of the PLT to identify strengths and needs of each member. The results can help schools tailor support to each teacher and help each teacher be more aware of their strengths and needs.

Future researchers can replicate the study and extend the time frame. Researchers can conduct the study as a longitudinal study to determine teacher perceptions of PLTs versus state test data for biology over time. In the research study, participants can answer survey items about their PLT each year as the researcher records the yearly state scores. This same type of longitudinal study also can be used to track the progress of PLT development using Graham and Ferriter's (2010) descriptions. The descriptions can help PLT leaders and members navigate difficulties and set themselves up to become more effective.

Future researchers can replicate the study in an ongoing basis to monitor needs of PLTs and changes within schools of different GLP ranges. The results also can be used to identify professional learning needs for biology PLTs. The results from this type of replication can provide information to further identify factors that are characteristic of PLTs of schools in different GLP ranges.

Any of the aforementioned future research ventures could include all demographic data originally used by Roberts (2010). Researchers could analyze results using the demographic data and compare them with Roberts's results.

Summary

In conclusion, research has shown PLTs are vehicles to connect, train, and mobilize teachers to meet the diverse needs of students using data. This research study sought to add to the body of knowledge of PLTs and their impact on teaching practices of biology teachers. This research study revealed teacher perceptions using Roberts's (2010) research design as a basis. Results supported portions of Roberts's findings on the perceived strengths and needs in ensuring all students learn at high levels, creating a collaborative culture, and focusing on academic results as described by DuFour (2004). As PLTs are intended to develop and change as the needs of shareholders change, educators must continue to research the effectiveness and focus of PLTs to support the evolution.

References

Blankenstein, A. M., Houston, P. D., & Cole, R. W. (2010). *The soul of educational leadership: Data enhanced leadership.* Corwin Press.

Browne, C. L. (2014). *Professional learning communities as a means for school-based science* (Publication No. 3620053) [Doctoral dissertation, Columbia University]. ProQuest LLC. https://doi.org/10.7916/D88C9TD1

Butin, D. W. (2010). *The education dissertation: A guide for practitioner scholars.* Corwin.

Byrd, C. M. (2016). Does culturally relevant teaching work? An examination from student perspectives. *SAGE Open, 6(3),* 1-10. http://doi.org/10.1177/2158244016660744

Cleophas, T. J., & Zwinderman, A. H. (2016). *Clinical data analysis on a pocket calculator: Understanding the scientific methods of statistical reasoning and hypothesis testing.* Springer International Publishing. https://doi.org/10.1007/978-3-319-27104-0

Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches* (4th ed.). SAGE.

Dalporto, H. (2019). *Building effective data strategies in career and technical education*. MDRC Center for Effective Career and Technical Education. https://files.eric.ed.gov/fulltext/ED600041.pdf

Danielson, C. (2006). *Teacher leadership that strengthens professional practice.* ASCD.

Drago-Severson, E. (2009). *Leading adult learning: Supporting adult development in our schools.* Corwin.

DuFour, R. (2004). Schools as learning communities: What is a "professional learning community?" *Educational Leadership, 61*(8), 6-11.

DuFour, R., & DuFour, R. (2012). *The school leader's guide to building a professional learning community at work.* Solution Tree Press.

DuFour, R., DuFour, R., Eaker, R., & Many, T. (2010). *Learning by doing: A handbook for professional learning communities at work* (2nd ed.). Solution Tree Press.

Eaker, R., DuFour, R., & DuFour, R. (2002). *Getting started: Reculturing schools to become professional learning communities*. Solution Tree Press.

Fischer, F. (1998). Beyond empiricism: Policy inquiry in postpositivist perspective. *Policy Studies Journal, 26*(1), 129-146. http://www.cddc.vt.edu/tps/e-print/PETER.htm

Fluid Surveys Team. (2014, October 8). Response rate statistics for online surveys: What numbers should you be aiming for? http://fluidsurveys.com/university/response-rate-statistics-online-surveys-aiming/

Foss, S. K., & Waters, W. (2016). *Destination dissertaion: A traveler's guide to a done dissertation* (2nd ed.). Rowman & Littlefield Publishing Group, Inc.

Friedman, T. L., & Mandelbaum, M. (2011). *That used to be us: How America fell behind in the world it invented and how we can come back.* Farrar, Straus & Giroux.

Frizellie, H., Schmidt, J. A., & Spiller, J. (2016). *Yes we can! General and special educators collaborating in a professional learning community.* Solution Tree, Inc. doi:https://eric.ed.gov/?q=+PLC+achievement+gap&ff1=dtySince_2016&id=ED574067

Fullan, M. (2001). *Leading in a culture of change.* John Wiley & Sons.

Genc, M. (2016). An evaluation of the cooperative learning process by sixth-grade students. *Research in Education, 95*(1), 19-32. http://doi.org/10.7227/RIE.0018

Gerzon, N., & Jones, B. (2020). Lessons learned about leading the implementation of formative assessment: A framework for school leaders and leadership teams. *West Ed*, 1-9. https://files.eric.ed.gov/fulltext/ED606088.pdf

Graham, P., & Ferriter, W. M. (2010). *Building a professional community at work: A guide to the first year.* Solution Tree Press.

Gray, E. K. (2018). *Middle school teachers' experiences with professional learning communities and reading strategies: A qualitative study* (Publication No. 10845272) [Dissertation, Capella University]. ProQuest LLC.

Gruenert, S., & Whitaker, T. (2015). *School culture rewired: How to define, assess and transform it.* ASCD.

Hae-Young, K. (2017). Statistical notes for clinical researchers: Chi-squared test and Fisher's exact test. *Restorative Dentistry and Endodontics, 42*(2), 152-155. http://doi.org/10.5395/rde.2017.42.2.152

Hall, G., & Hord, S. (2015). *Implementing change: Patterns, pinciples, and potholes.* Pearson Education, Inc.

Johnston-Estes, L. L. (2009). *An analysis of the relationship of professional learning community implementation in Texas high schools and student achievement* (Publication No. 3358169) [Doctoral dissertation, Tarleton State University]. ProQuest Dissertations Publishing.

Kincannon, S. D. (2010). *A study of professional learning communities and science achievement in large high schools* (Publication No. 3407799) [Doctoral dissertation, Baylor University]. ProQuest LLC. https://search.proquest.com/docview/522107057

Krosnick, J. A., & Presser, S. (2010). Question and questionnaire design. In J. D.Wright & P. V. Marsden (Eds.), *Handbook of survey research* (2nd ed., pp. 263-313). Emerald Group Publishing Limited. https://web.stanford.edu/dept/communication/faculty/krosnick/docs/2009/2009_handbook_krosnick.pdf

Lambert, L., Walker, D., Zimmerman, D., Cooper, J., & Lambert, M. (2002). *The constructivist leader* (2nd ed.). Teacher College Press.

Laughter, J. C., & Adams, A. D. (2012). Culturally relevant science teaching in middle school. *Urban Education, 47*(6), 1106-1134. http://doi.org/10.1177/0042085912454443

Lund Research Ltd. (2012). *Quantitative dissertation route #1*. http://dissertation.laerd.com/route1-getting-started.php/

Lund Research Ltd. (2018a). *Measures of central tendency*. https://statistics.laerd.com/statistical-guides/measures-central-tendency-mean-mode-median.php

Lund Research Ltd. (2018b). *Measures of spread*. https://statistics.laerd.com/statistical-guides/measures-of-spread-range-quartiles.php

Lund Research Ltd. (2018c). *One-way ANOVA in SPSS Statistics.* https://statistics.laerd.com/spss-tutorials/one-way-anova-using-spss-statistics.php

McDonald, J. H. (2014). *Handbook of biological statistics* (3rd ed.). Sparky House Publishing. http://www.biostathandbook.com/fishers.html

McREL International. (2009). *North Carolina educator evaluation process teacher manual.* http://ncees.ncdpi.wikispaces.net/NCEES%20Wiki

Millar, M. M., & Dillman, D. A. (2011). Improving response to web and mixed-mode surveys. *Public Opinion Quarterly, 75*(2), 249-269. https://doi.org/10.1093/poq/nfr003

Morgan, G. (2006). *Images of organization.* Sage Publications, Inc.

Naisbitt, J. (2006). *Mindset: Eleven ways to change the way you see and create the future.* Collins Business.

National Council of Supervisors of Mathematics & National Council of Teachers of Mathematics. (2018). *Building STEM education on a sound mathematical foundation.* National Council of Supervisors of Mathematics. https://www.nctm.org/uploadedFiles/Standards_and_Positions/Position_Statements/Building%20STEM%20Education%20on%20a%20Sound%20Mathematical%20Foundation%20(NCSM-NCTM%202018).pdf

National Research Council. (1985). *Indicators of precollege education in science and mathematics: A preliminary review.* National Academies Press. http://doi.org/10.17226/238

National Research Council. (2014). *Developing assessemnts for the next generation science standards.* Division of Behavioral and Social Sciences and Education. National Academy of Sciences. http://sites.nationalacademies.org/cs/groups/dbassesite/documents/webpage/dbasse_086205.pdf

National Research Council Committee on High-School Biology Education. (1989). Issues in objectives and evaluation. In W. Rosen, (Ed.), *High-school biology today and tomorrow: Papers presented at a conference.* National Academies Press. https://www.ncbi.nlm.nih.gov/books/NBK218794

National Science & Technology Council. (2018). *Charting a course for success: America's strategy for stem.* Committee on STEM Education. Office of Science and Technology Policy. https://www.whitehouse.gov/wp-content/uploads/2018/12/STEM-Education-Strategic-Plan-2018.pdf

National Science Board. (1983). *Educating Americans for the 21st century: A plan of action for improving mathematics, science and technology education for all American elementary and secondary students so that their achievement is the best in the world by 1995.* National Science Foundation. https://www.worldcat.org/title/educating-americans-for-the-21st-century-a-plan-of-action-for-improving-mathematics-science-and-technology-education-for-all-american-elementary-and-secondary-students-so-that-their-achievement-is-the-best-in-the-world-by-19

National Science Board. (2018). *Science and engineering indicators 2018.* National Science Board. https://www.nsf.gov/statistics/2018/nsb20181/report/sections/elementary-and-secondary-mathematics-and-science-education/highlights

National Science Board Commission on Precollege Education in Mathematics, Science, and Technology. (1983). Educating Americans for the 21st century: Executive summary. *Education Week.* https://www.edweek.org/ew/articles/1983/09/14/04020001.h03.html

North Carolina Department of Public Instruction. (2014). North Carolina end-of-course biology test. http://www.dpi.state.nc.us/docs/accountability/testing/achievelevels/eocbioald14.pdf

North Carolina Department of Public Instruction. (2017). 2016-17 North Carolina school accountability data release technical note. http://www.ncpublicschools.org/docs/accountability/reporting/2017/documentation/datarlstchnts17.pdf

North Carolina Department of Public Instruction. (2019). Achievement level results. NCDPI Division of Accountability Services. https://files.nc.gov/dpi/documents/files/achievementlevelresults_1819.pdf

Ramshaw, A. (n.d.). *The complete guide to acceptable survey response rates.* https://www.genroe.com/blog/acceptable-survey-response-rate-2/11504

Raviv, A., Cohen, S., & Aflalo, E. (2019). How should students learn in the school science laboratory?: The benefits of cooperative learning. *Research in Science Education*, *49*(2), 331-345. https://eric.ed.gov/?q=cooperative+learning+and+science+student+achievement&ff1=dtySince_2016&id=EJ1211076

Reitz, H. E. (2018). *Investigating the link between a middle-level geography professional learning community and classroom practice* (Publications No. 10788140) [Doctoral dissertation, Northern Illinois University]. ProQuest LLC. https://search.proquest.com/docview/2055791578

Reynolds, D. (2008). *How professional learning communities use student data for improving achievement* (Publication No. 3324969) [Doctoral dissertation, University of Southern California]. ProQuest LLC. http://digitallibrary.usc.edu/cdm/ref/collection/p15799coll127/id/71149

Roberts, M. (2010). *Improving student achievement through professional learning communities* (Publication No. 3427792) [Doctoral dissertation, University of Nebraska-Lincoln]. ProQuest LLC. https://digitalcommons.unl.edu/dissertations/AAI3427792/

Salkind, N. J. (Ed.) (2010). *Encyclopedia of research design*. SAGE Publications, Inc. http://methods.sagepub.com/reference/encyc-of-research-design

Schachter, R. E., Gerde, H. K., & Hatton-Bowers, H. (2019). Guidelines for selecting professional development for early childhood teachers. *Early Childhood Education Journal, 47*(4), 395-408. https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1282&context=famconfacpub

Senge, P. M. (1990). The leader's new work: Building learning organizations. *MIT Sloan Management Review, 32*(1). https://sloanreview.mit.edu/

Senge, P. M. (2006). *The fifth discipline: The art and practice of the learning organization.* Doubleday.

Sims, R. L. (2013). *Understanding the perceptions of teachers in a professional learning community* (Publication No. 3597256.) [Doctoral dissertation, Walden University]. ProQuest LLC. https://search-proquest-com.ezproxy.gardner-webb.edu/pqdthss/docview/1452321138/176B3FB6A3394D31PQ/2?accountid=11041

Squires, J., & Milburn, P. (2018). *CEELO leadership professional learning community: Final report.* Center on Enhancing Early Learning Outcomes. https://eric.ed.gov/?q=+PLC+plan&id=ED592988

Themat, V., & Ver Loren, J. (2019). Thinking together changes the educational experiences, provision and outcomes for SEND pupils: Professional learning communities enhancing pactice, pedagogy and innovation. *Support for Learning, 34*(3), 290-311. https://eric.ed.gov/?q=need+for+continued+professional+learning+for+student+achievement&id=EJ1230848

Thompson, S. C., Gregg, L., & Niska, J. M. (2004). Professional learning communities, leadership, and student learning. *Research in Middle Level Education Online, 28*(1), 1-15. http://www.nmsa.org/Publications/RMLEOnline/tabid/101/Default.aspx

Vescio, V., Ross, D., & Adams, A. (2007). A review of research on the impact of professional learning communities on teaching practice and student learning. *Teaching and Teacher Education, 24,* 80-91. http://doi.org/10.1016/j.tate.2007.01.004

Appendix A

IRB Approval

KS

Kathi Simpson
Wed 9/4/2019 2:05 PM
Rowena Dawkins; Sydney Brown

Ms. Dawkins,
Your IRB Application for the Exempt research project titled "Relationships between Perceptions of Professional Learning Team Skills and Student Achievement in High School Biology" has been approved, effective September 4, 2019. It has been assigned an expiration date of September 3, 2020, and an IRB file number of 19082101.

Please be aware that if you need to continue your study beyond the Expiration Date, you must submit a Request for Continuance (http://www.gardner-webb.edu/Assets/gardnerwebb/academics/review-board/irb-request-research-continuance1.pdf) prior to that date.

Best wishes for a productive investigation!

Kathi Simpson
Office Manager
ORIC Administrative Assistant
Gayle Bolt Price School of Graduate Studies
P (704) 406-3020 | F (704) 406-3859

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Appendix B

Consent from Mindy Roberts to Use the Survey

Requesting permission to use elements from your PLC study from 2010

Rowena Dawkins Thu, Aug 2, 2018 at 2:19 PM
To: Mindy Roberts

Dear Dr. Roberts,

Thank you so much!

Sincerely,

Rowena

On Tue, Jul 31, 2018 at 9:43 PM, Mindy Roberts wrote:

> Rowenda,
> You can use my survey. Good luck with your research and please send me a summary of your findings.

Appendix C

Consent from William Ferriter to Use the Task Chart for Item 8

william ferriter
to me

Sun, Sep 17, 2017, 7:11 AM

Hey Rowena,

Second, you have my permission to adapt the surveys in BPLC as long as they are only used in your doctoral research and are not later republished for use in any way or by anyone.

Let me know if you have any questions,
Bill Ferriter

Appendix D

Themes

Survey items	Identified themes
10. What personal strengths do you believe you have to ensure students learn at high levels?	Relationships with students Application of the concepts Teachers were aware that students are on different educational levels
11. What skills do you believe you still need to acquire to help students achieve at high levels?	Differentiation for different population Improvements in labs Students actively involved in and responsible for their education
13. What are the strengths of your weekly PLT that have helped to create a collaborative culture?	Communication Actively collaborate
14. What skills do you believe your weekly PLT still needs to acquire to help create a collaborative culture?	Assessments Student learning
16. What are the strengths of your weekly PLT that have helped the PLT focus on academic results?	Use of data Cooperation/Collaboration
17. What skills do you believe your weekly PLT still needs to acquire to assist in focusing on academic results?	Forming and sharing results of common assessments Supporting student subgroups

	Themes of survey item 20
Rate the impact of your participation in your weekly PLT meeting on your teaching practices.	Explain why you choose that degree of impact in item18.
Not impacted	No benefit
Survey item 18	Growth/improvement in teaching practices (lack of)
Impacted [Slightly, Moderately, Very, & Extremely]	Data
	Ideas

Survey item 19	Themes of survey item 20
IF your teaching practices were impacted by your participation in your weekly PLT meeting, describe the type of impact.	Explain why you choose that degree of impact.
Positive impact only	Data
	Ideas
Positive & negative impacted	Data
Negative impacted only	No participant responses