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Perceptions of Secondary Administrators: Looking at Their Experiences and Practices Supporting Science Instruction

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PERCEPTIONS OF SECONDARY ADMINISTRATORS: LOOKING AT THEIR EXPERIENCES AND PRACTICES SUPPORTING SCIENCE INSTRUCTION

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ABSTRACT

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Secondary school administrators play a vital role as instructional leaders, specifically those that are aimed at improving students' learning of science content (Hill & Grossman, 2013). Unfortunately, administrators rarely have a background in science (Halverson et al., 2011). Little is known about an administrator's knowledge of science practices and their ability to support science instruction at the secondary level. The purpose of this mixed-methods study was to explore the relationship between the structure and focus of an administrator's instructional roles and their capacity to foster quality science support and instruction for teachers and students. Administrators' perceptions of effective support actions were captured from Q-Methodology sorts, a post-sort questionnaire, and focus group interviews, which are part of the InQuiry research method. Questionnaire responses and interviews were also used to explore what administrators noticed during a science lesson and the type of feedback and support they would provide a teacher. Three distinct administrator perspectives emerged from the data collected in this study: Effective Encouragers; R.E.C. (Relationships, Encouragement and Curriculum) League; and Eye in the Sky. Findings were consistent with previous research about instructional leadership and science practices. Participants valued positive teacher-student relationships and high expectations for all students, but how they went about supporting teachers was very different. There is a need for developing the capacity of administrators to effectively support teachers in their implementation of the science practices reflected in current reform efforts.

I dedicate this dissertation to my parents, Dr. Annie Ferrell and Mr. Vernard Ferrell.
I am so very blessed to have you both in my life encouraging me every step of the way.

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CHAPTER 1

Significant changes have occurred in school leadership over the last 25 years, connecting theoretical concepts of leadership to student learning (Myran & Sutherland, 2018). School leadership is a vital component of education and educational reform (Leithwood et al., 2004). Effective leaders must be capable of promoting and sustaining an environment stable enough to attract, acquire, and support the development of good teachers (Khalifa et al., 2016). School leaders must be visible in the classroom observing instruction and conducting ongoing pre- and post-observation conferences with their teachers (Kafele, 2019). An important component of these discussions is assisting teachers with creating and developing a truly equitable learning environment, and then looking for evidence of good instruction during observations (Kafele, 2019). Instructional leadership is now the primary role of a school administrator. Principals are expected to be instructional leaders and are held accountable for their school's success (Kafele, 2019). This is the result of a shift from an emphasis on the management of schools to supporting and informing instruction and it requires administrators to be trained differently (Konan & Çavuşoğlu, 2018). These practices evolved from sensemaking and instructional leadership theory. For administrators and teachers in this study, sensemaking is a process that people use to give meaning to experiences; however, administrators are not the only ones whose roles must change in pursuit of student achievement. Teachers must demonstrate their understanding of pedagogical practices through differentiating instruction, creating personalized learning opportunities, and helping students with sensemaking of science concepts (Finley, 2014). Sensemaking of science for students is the figuring out of a concept or how teachers try to fill the gap in their students' understanding of phenomena (Odden & Russ, 2018). The role of instructional leaders is to develop and improve instruction in ways that result in improved student performance (Khalifa et al., 2016).

Virginia's public schools receive state and federal accountability ratings that are based on the performance of their students on state assessments in English, mathematics, and science; achievement gaps; chronic absenteeism; dropout rate; and graduation/completion index (Virginia Department of Education [VDOE], 2019). Two of the accountability measures listed are Science, Technology, Engineering, and Mathematics (STEM) disciplines. If there is an instructional focus placed on these disciplines it will lead to students understanding the bigger picture—the "why" and not just the "how." Students need to grasp the essence of science, which is asking questions, conducting investigations, collecting and analyzing data, and communicating results (VDOE, 2019). "In science, students need to understand what is meant, for example, by an observation, a hypothesis, an inference, a model, a theory, or a claim and be able to distinguish among them" Epistemic knowledge is the knowledge of the constructs and values that are intrinsic to a discipline (National Research Council [NRC], 2012, p.79). Also, these are concepts that should be understood by all educated citizens to make informed decisions on global science issues. Unfortunately, not all students have access to this knowledge and therefore could be unprepared for or uninterested in a STEM career. Students in schools where teachers are poorly prepared to teach science might lack the passion or the foundation to pursue a career in a STEM-related field (Fayer et al., 2017).

The purpose of this chapter is to reflect on Virginia's accountability system through the lens of science and instructional leadership. This chapter begins with a review of both the national and state accountability systems and their impact on science reform, with a clear picture of how accountability changes affect science instruction in the classroom, followed by a look at instructional leaders, content knowledge, their understanding of scientific literacy, and their ability to conduct observations and provide feedback and support to science teachers. A reflection of the administrators' efficacy towards the delivery and support of science instruction is addressed. The implications for Virginia's school leaders and how they can be helped to recognize quality science instruction and improve teaching practices is discussed. Next, I address the problem statement and the sensemaking theory that will serve as the theoretical framework to explore selected administrators' knowledge, resources, and skills to understand and support educational reforms in science. An overview of the methodology will follow. The chapter concludes with the significance of the current study, and the definitions of terms used in researching and reporting my findings.

Background of the Current Study

In 2015, Every Student Succeeds Act (ESSA) replaced the 2001 No Child Left Behind Act (NCLB) as the country's K-12 education policy (Jimenez & Sargrad, 2017). The purpose was to improve the quality of public education. NCLB brought *proficiency rates* and *Adequate Yearly Progress* to school leaders' vocabulary (U.S. Department of Education, 2019). It also put measures in place that exposed achievement gaps between underrepresented students and their counterparts. This policy brought to light the need for ensuring all students have the opportunity to receive a quality education (McGrath et al., 2018). The Obama administration sought to correct the problems with NCLB by working with states to create plans to close achievement gaps, increase equity, improve the quality of instruction, and improve outcomes for all students (U.S. Department of Education, 2019). ESSA requires all students to be held to high academic standards, addresses equity issues for disadvantaged students, requires statewide assessments that measure students' progress be transparent for all stakeholders, increases access to preschool, and provides accountability and support to low performing schools (McGrath et al., 2018). Some problems remain with the current policy and the states that do not have a more comprehensive plan (Jimenez & Sargrad, 2017). An accountability system is needed that not only explains what the outcomes were, but also shares how they were reached. Without a robust accountability system, there will be unintended consequences of accountability policies. One example is that teachers and administrators will focus on the areas that are currently being assessed at the state level while not addressing other areas of content that provide those foundational skills that students will need in the later years that are assessed.

NCLB had several concerning problems, such as an increased achievement gap between Black and White students because the performance of Blacks improved less than that of Whites (U.S. Department of Education, 2019). NCLB led to higher drop-out rates; cheating on achievement tests by schools and administrators; undesirable practices, such as teaching to the test; and students learning content in isolation, instead of an interdisciplinary approach (Jimenez & Sargrad, 2017). It also caused schools to track students and place more students in special education classes to avoid state tests, which resulted in artificially higher student achievement scores for schools who tracked low-performing students into special education classes (Berwick, 2015). Those who suffered the most were the students in the stakeholder group that the accountability system was designed to protect (Berwick, 2015). The current era of test-based accountability has resulted in an environment where districts and schools are graded, and this information is reviewed by the public to determine where families settle. The goal is to prepare students to be college and career ready and the accountability system should ensure this goal.

In Virginia, schools are identified for support and improvement on multiple performance indicators based on ESSA (Virginia Department of Education, n.d.-b). Those indicators were academic achievement (math, reading and science), which was measured by looking at pass rates on the Standards of Learning; the Virginia Alternate Assessment Program high school graduation rates; growth in reading and math; progress among English Learners; chronic absenteeism; and school accreditation ratings (Virginia Department of Education, n.d.-a). The newly revised state accreditation standards include overall achievement while measuring student performance on multiple school-quality indicators. The overall proficiency and growth in English reading/writing achievement, overall proficiency and growth in mathematics, and overall proficiency in science (VDOE, 2018). The 2019-2020 school year called for a waiver on these accountability measures based on the COVID-19 pandemic. Virginia's Superintendent of Public Instruction sent a letter to the Assistant Secretary for Elementary and Secondary Education in the U.S. Department of Education's office on March 23, 2020, requesting a waiver based on the Elementary and Secondary Education Act (ESEA) of 1965 (Lane, 2020). This request was based on districts' inability to administer assessments due to school closures. An unforeseen contingency was that any school that had been identified as needing comprehensive or targeted support and improvement during the previous school year would maintain that identification status next school year and receive support based on the improvement plan.

When looking at recent science reforms there was a need for a new vision where students are engaged in the science practices (Cherbow et al., 2020). The idea of science as a set of practices originated from the values and norms that were used by scientists to establish reliable scientific knowledge (Windschitl et al., 2008). These science practices focused on using evidence-based explanations of how the natural world works and why it works that way (Krajcik et al., 2014). While in education, the Next Generation Science Standards (NGSS) described eight science practices as the main activities and as essential learning outcomes for students (Osborne, 2014). In many classrooms, inquiry-based science reform meant that students would explore the relationship between two variables to support or reject a hypothesis but not explain phenomena (Reiser et al., 2017). These science reforms had standards that aligned to the vision of science as a practice and stray away from science standards that based on the memorization of facts over the application of the knowledge (Banilower et al., 2018). Despite the new science standards K-12 science instruction remains teacher-driven and focused on the memorization of discreet facts instead of learning and applying the knowledge of the science practices (Cherbow et al., 2020). Accountability reforms have not been content-neutral; they have elevated some school subjects over others, with an emphasis on literacy and mathematics as core content areas within the accountability system (Spillane, 2005). However, recent science reform efforts have brought science and engineering into the forefront (Bybee, 2014). In response to this new emphasis on science, the NGSS emerged as a key set of standards promoted on a national level with states developing their own standards that closely mirror the national standards (NGSS Lead States, 2013).

Educational leaders have the responsibility not only to understand and meet accountability requirements, but also to guarantee a high-quality educational experience for all students (Leithwood et al., 2004). Educational leaders are held accountable for their district and must ensure that each component of the hierarchy of the organization meets the accountability requirements (Morgan, 2007). District-level leaders and administrators can design and embed structures and supports that encourage success, both at the district and individual school levels. Educational accountability operates on a pendulum, as do most educational movements, and educational leaders must be able to successfully navigate those changes. Additionally, becoming aware and knowledgeable about accountability changes can help school leaders recognize sensitive dependence (Shoup & Studer, 2010, p. 17), which is when small changes can have a big effect. Leaders also need to understand that systems emerge and grow in different directions. Being prepared to support educators on strange attractors, or the reasons why certain practices exists (Shoup & Studer, 2010, p. 10) can be powerful as they develop the non-negotiables of what best instructional practices are for students.

STEM (Science, Technology, Engineering, and Mathematics)

"STEM is a curriculum that is based on the idea of educating students in four specific disciplines which are science, technology, engineering, and mathematics in an interdisciplinary and applied approach" (Hom, 2014). "Rather than teach the four disciplines as separate and discrete subjects, STEM integrates them into a cohesive learning paradigm that is based on real-world applications" (Hom, 2014). The U.S. Department of Education (2018) reported that only 16% of high school students were interested in a STEM career. Although 28% of high school freshmen declared an interest in a STEM-related field, by graduation over 57% of those students have lost interest in STEM. In 2014, President Obama and his administration invested $3.1 billion in federal programs that focused on STEM education, which was an increase of 6.7% over the budget in 2012 (Handelsman & Smith, 2016). The budget included areas such as the recruitment and support of STEM teachers in K-12 education and the support of STEM-focused high schools. STEM blends the learning environment and allows students to apply the nature of science to their daily lives.

Nature of Science

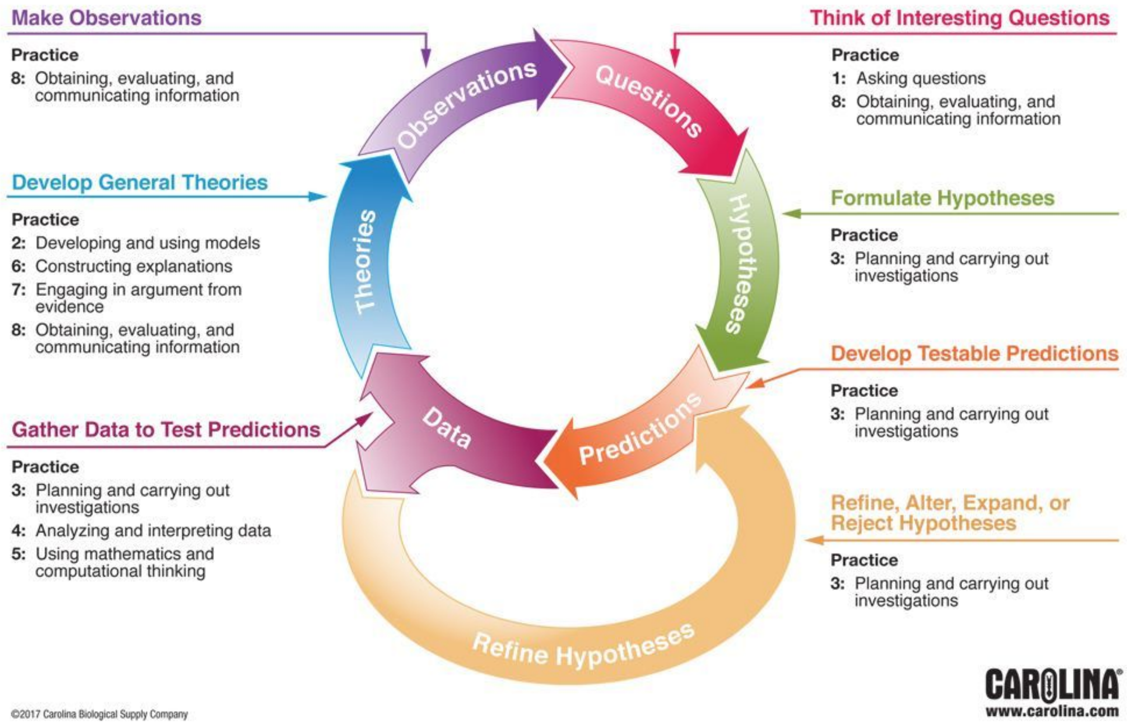
The nature of science explains what science is, describes how it develops, builds the knowledge it generates, and clarifies the methodology to disseminate and validate knowledge (VDOE, 2018). The need to know and understand how the world works led to discoveries and changes in life (NGSS, 2013). We also have a desire to change the world to improve our lives and that requires the use of technology to change our environment (NGSS, 2013). The need to know is sometimes a natural curiosity about how the world works and how nature should remain in balance (NGSS, 2013). Science is how we explain the natural world, but technology and engineering are how humans make it habitable (NGSS, 2013). A goal for science education is that all students become scientifically literate citizens who can understand the nature of science to better understand their world. The tenets of the nature of science are as follows:

- Scientific Investigations Use a Variety of Methods
- Scientific Knowledge is Based on Empirical Evidence
- Scientific Knowledge is Open to Revision in Light of New Evidence
- Scientific Models, Laws, Mechanisms, and Theories Explain Natural Phenomena
- Science is a Way of Knowing
- Scientific Knowledge Assumes an Order and Consistency in Natural Systems
- Science is a Human Endeavor
- Science Addresses Questions About the Natural and Material World

The first four of these understandings are associated with science practices and the second four are crosscutting concepts. The instructional model that places the scientific and engineering practices (SEPs) in the first dimension because, regardless of the specific field, these are present in every scientific discipline (see Figure 1). The conceptual thinking, or how students will make sense of the new information, falls under the second dimension of crosscutting concepts (Whitaker, 2018). When students experience learning that emphasizes explanations that are based on evidence, and natural phenomena then their knowledge and understanding of the science practices will be evident (NRC, 2012).

Figure 1

Science and Engineering Practices and Crosscutting Concepts



Note. Reprinted from Carolina Biological Supply Company in 2017.

The U.S. is believed to be the world leader in science and technology, but a look at its achievement gaps in science shows that this lead will be short-lived unless there is a change in its education system (National Science Foundation [NSF], 2018). Students in the U.S. are behind those in China, Russia, and other countries in science (NSF, 2018). Children's understanding of science concepts is increased when they are encouraged to make observations of the natural world around them (NRC, 2012). They must be shown how to make explicit connections and be able to explain their findings. These connections are especially beneficial for marginalized students. Children who are considered less knowledgeable or disadvantaged need help making these connections starting in elementary school. Teachers need to ensure that their students who are disadvantage are offered additional educational opportunities as they move through school to deepen their epistemic cognition (Jee, 2019). Epistemic cognition is the way a person reflects on their certainty of knowledge how they have obtained that knowledge and evaluate the sources of knowledge. Teachers require support to successfully integrate teaching practices that include all students, especially in the area of science instruction (NRC, 2012). Teachers receive that support through ongoing professional development and strong instructional leadership at their schools.

Instructional Leadership and Science

School administrators are expected to provide strong instructional leadership in their schools. This is seen through evaluation systems that are meant to impact teacher learning, improve classroom instruction, and increase student achievement (Leithwood et al., 2004). Much of this leadership includes observing classroom instruction and providing feedback to teachers (Lochmiller, 2016; Marshall, 2009; Reinhorn et al., 2017). School administrators are responsible for supervising teachers across multiple subject areas (Sergiovanni et al., 2013). Science was the focus of this study. The role of the administrator can be vital to high-quality science instruction (Wenner & Settlage, 2015). There is not enough known about an administrator’s capacities to support science instruction in the classroom (Halverson et al., 2011). Therefore, when the focus is placed on an administrator's knowledge of science practices, there is a challenge for schools implementing science standards, such as the Next Generation Science Standards (NGSS; Bybee, 2014). NGSS has three categories of science practices—investigating, sensemaking, and critiquing—that students should be able to apply in diverse contexts as they engage in these practices (NRC, 2012). Teachers require administrative support to successfully integrate science practices into their instruction (NRC, 2012).

Problem Statement

High-stakes accountability in reading and mathematics have demanded the time of administrators and left very little time for science (NRC, 2015). Another concern is that many administrators do not have a science background and might not understand how best to support their teachers in science (NRC, 2015). The purpose of this mixed-methods study was to explore the relationship between the structure and focus of an administrator's instructional roles and their capacity to foster quality science support and instruction for teachers and students. In this study, I explored evidence of administrators recognizing good science instruction and supporting good science practices in their teachers. The school district chosen for this study was a newly fully accredited one, with very diverse student populations. Interviews and observations were conducted with secondary assistant principals and principals, and reviews of the schools' and the district's strategic plans were done to provide additional context for the views of the school administrators, teachers, and students. It is not known how or why secondary administrators struggle to provide feedback that will improve the performance of science teachers at their schools (Halverson et al., 2011). Recent science reforms that are aimed at improving students' learning of science content, such as the NGSS, require administrators to provide specific feedback to each discipline (Hill & Grossman, 2013). Unfortunately, administrators rarely have a background in science (Halverson et al., 2011). The purpose of this study was to investigate secondary school-based administrators' perceptions of their support for science instruction. Specifically, this study was guided by the following questions:

1. What are secondary school administrators' perceptions of effective support and feedback to classroom teachers?

2. What do secondary administrators notice when watching science instruction?

3. How comfortable are secondary administrators at supporting and delivering effective feedback in science classrooms?

Theoretical Framework

Sensemaking Theory

Administrators lacking a background in science raises the question of what they perceive to be high-quality science instruction. In this mixed methods study, I investigated selected administrators' perceptions of good science instruction. Sensemaking theory was the theoretical framework. Sensemaking originates from the work of Karl Weick and refers to how meaning making occurs. Sensemaking is a framework for understanding perception, cognition, action and memory (Weick, 1995). It also allows leaders to get a better understanding of what is happening in their environment. Sensemaking is an ongoing process; however, the need increases when leaders are faced with new situations without a clear course of action. Sensemaking also allows for the testing meanings with others via action and then refining our understandings or abandoning them in favor of new ones (Weick, 1995). These experiences can be looked at retrospectively to identify patterns and changes over time (Weick, 1995). Sensemaking can be described in three steps. The first step is where circumstances are categorized, next the categories are written and spoken, and finally this is where reading, writing, editing actions occur and begin to shape behavior (Weick et al, 2005). Another way to look at sensemaking is there is an event that happens, next there is the question of what does that event mean, and finally what happens next (Weick et al., 2005).

Sensemaking is about giving meaning to experience when a situation is uncertain or ambiguous (Jäppinen, 2014). It is how educational leaders make meaning of their environment and it can affect "the nature and depth of change" (Weiner & Woulfin, 2018, p. 215). It is often argued that sensemaking is the missing link between the types of leadership and the actual work of a leader (Thomason & Hall, 2011). If education is a shared learning action, then the self-efficacy of the leaders and the teachers must be considered (Bandura, 1994). Collective efficacy and collaboration must be examined as well (Bandura, 1999). Leaders can construct different meanings related to the elements of teacher leadership, which can guide the leaders' work and inform practices and processes in their schools (Weiner & Woulfin, 2018). Sensemaking theory allows for a better understanding of how and why social and organizational context in schools shape opportunities to learn, collaborate, and shift practice (Weiner & Woulfin, 2018). Sensemaking is not about the correct response, but it is about getting a more complete picture and as more evidence is uncovered then beliefs and actions will evolve as well (Weick et al., 2005).

Research Methodology

Research Design

The mixed methods study used the Q methodology to group the perceptions of selected secondary school administrators and their support of secondary science teachers. The administrators engaged in a sorting activity to provide a visual representation of their perceptions of effective feedback. Q methodology provided groupings of specific viewpoints that would be difficult to discern through an interview. The study began with a collection of statements generated from interviews with teachers and administrators and an extensive literature review. This list of statements that identifies administrators' perceptions of effective feedback is called the concourse. A Q sample or Q set, which is a representative sample of statements, was generated from the concourse. The participants, P sample or P set, were secondary administrators in an urban school district. The participants conducted a sort of the Q sample statements in response to a generative question based on their perception of importance. The generative question used in this study was: "What are the most effective actions that I can take right now to help teachers improve instruction?"

A statistical factor analysis was performed to identify significant perspectives and the characteristics of each perspective. Additional post-sort interviews were conducted to gain further insights into participants' responses as part of the InQuiry process (Militello et al., 2016). The participants watched a brief clip from a secondary science class and were asked what feedback they would provide this teacher. The InQuiry approach prompted administrators to share their perceptions about effective feedback for teachers, specifically science teachers, based on their experiences (Militello et al., 2016). The participants shared that they drew on their experiences as a classroom teacher that received feedback from an administrator, as a student that completed an administrative program, and as an administrator that has delivered feedback to teachers. If each of these perceptions is valid and must be accepted as truths, then it is necessary to acknowledge each of these truths to gain insight. The desired outcome is to expand the administrators' perspective of effective feedback for science teachers.

The first research question focused on secondary school administrators' perceptions of effective support and feedback to classroom teachers. The second and third research questions focused on how comfortable secondary administrators were at supporting and delivering effective feedback in science classrooms respectively. The Q Methodology is a technique that reveals the divergent and consensus views of the participants (Militello et al., 2013). It allows a researcher to study the perceptions of individuals and systematically analyze multiple perspectives. Q-methodology allows participants to make decisions about what is meaningful, what has value, and what is significant from their perspective (Militello et al., 2013).

Significance of the Study

Teachers create an environment where strong science instruction impacts student achievement; school leaders need to be able to provide feedback to their science teachers. Administrators perceive their feedback helps improve science instruction in their schools (McNeil et al., 2018). Administrators' perceptions of effective scientific practices and how their feedback supports their science teachers is important because it allows them an opportunity to contribute to improving science instruction in their school (McNeil et al., 2018). The data collected in the current study will lead to an increased awareness of how administrators affect secondary science teachers' instruction and student success. The study provided an opportunity to understand the perceptions of secondary administrators and the feedback they offer their teachers that is the most meaningful (Militello et al., 2016). School leaders may use the findings from this study to improve their feedback and support for science teachers.

The research and design of this study provide a unique view of how administrators perceive the support and feedback they give to classroom teachers. Findings may lead to professional development that school districts will create to improve administrator support and effective feedback for secondary science teachers.

Definition of Terms

Critiquing Practices involve engaging in argument from evidence or evaluating information and students questioning and evaluating each other's ideas (NGSS, 2018).

Investigating Practices involve asking questions, planning, and carrying out investigations, or using mathematical and computational thinking. They also involve collecting data, conducting experiments, and observing phenomena (NGSS, 2013).

Observational feedback is an approach that will encourage teachers to analyze, critique, reflect, and revise their instructional practices. It should move beyond general pedagogy and student engagement to include science practices (McNeil et al., 2018).

P sample is the active participants in the study who will perform the sorting activity (Militello et al., 2013).

Q sample is the list of statements that participants will sort (Militello et al., 2013).

Sensemaking Practices involve developing and using models, analyzing and interpreting data, or constructing explanations to explain how or why a phenomenon occurs (NGSS, 2013). In this study participants utilized sensemaking when they reflected on their experiences to sort the statements and identify the noticings during the science video.

Teacher efficacy is the belief in one’s ability to successfully manage tasks and challenges as they relate to their professional role (Bandura, 1999).

Organization of the Study

Chapter 2 provides a review of relevant extant literature. The literature review covers instructional leadership, sensemaking theory, and science practices. In Chapter 3, a comprehensive account details the methods used for the current study. The Q Methodology and the case study approach are described. Chapter 3 includes practices used for data collection and analysis to determine the emergent themes for instruction leadership in supporting science instruction.

Chapter 4 details the findings of the study. The findings include the analyses of both the Q methodology sample and the case study of instructional leadership and sensemaking for administrators. The themes that emerged from the case study analyses of the participants are discussed. Chapter 5 contains the summary, conclusions, and recommendations of the study. Chapter 5 also includes a discussion of the emergent themes that detail the extent to which secondary administrators are supportive of science teachers, can notice and understand science practices, and provide beneficial feedback to improve science instruction. Chapter 5 concludes with recommendations for secondary administrators supporting science instruction.

Conclusion

Chapter 1 provided an overview of the relationship between an administrator's instructional role and their capacity to recognize and support quality science instruction for teachers and students. Administrators must understand science practices, effectively facilitate conversations related to science instruction, and provide quality feedback that is supportive to teachers and assists them in improving their science instruction in the classroom (McNeil et al., 2018). The focus of this study was to investigate secondary school-based administrators' perceptions of their support for science instruction.

CHAPTER 2

Literature Review

This literature review focuses on science practices and the influence of instructional leadership on science instruction at the secondary level. The first section provides a discussion of effective science practices from a pedagogical perspective that involves the science teacher and student. The theories of self-efficacy and social networks are addressed as they connect to the science practices and instructional leadership. The second section discusses the components of instructional leadership at the secondary level and the roles of an instructional leader who is supporting science, namely observing teachers, providing observational feedback to teachers, noticing and interpreting science practices in the classroom, and evaluating science teachers. Instructional leadership and its connection to sensemaking theory are discussed. This chapter concludes with a discussion of the ways science practices influence classroom instruction and how instructional leadership support influences student achievement in science classes.

Introduction to Science Practices

A vital part of science education is learning science concepts and embedding scientific and engineering practices within each science discipline. Students must grasp the very nature of science, which is asking questions, conducting investigations, collecting data, analyzing the data, and communicating the results (VDOE, 2019).

> Epistemic knowledge is knowledge of the constructs and values that are intrinsic to science. Students need to understand what is meant, for example, by making an observation or an inference, formulating a hypothesis, constructing a model, testing a theory, or presenting a claim and be able to distinguish among them. (NRC, 2012, p. 79)

When students use science practices, their knowledge deepens, and they develop an appreciation and understanding of the world around them. They can investigate, model, and explain phenomena in nature (NRC, 2012). Students can recognize the importance of science in their daily lives. Many challenges that we encounter in society, such as generating sufficient energy, preventing and treating disease, maintaining freshwater and food supplies, and solving problems that arise from climate change can be solved through science and engineering (NRC, 2015).

Science Practices

"Nature of science (NOS) is a critical component of scientific literacy that enhances students' understandings of science concepts and enables them to make informed decisions about scientifically-based personal and societal issues" (National Science Teachers Association [NSTA], 2018). Nature of science draws upon the eight science practices, the observations of the natural world, testing scientific understandings, and methods of inquiry (NSTA, 2018). Those who study the nature of science and the skills needed to learn science have different perspectives on the scientific practices and identify different elements as required best practices for teaching science (Duschl et al., 2007; Grandy & Duschl, 2005; Stanovich, 2003). One view of science is as a process of logical reasoning about evidence focuses on the skill of thinking scientifically to acquire problem-solving strategies for theory and evidence (Duschl et al., 2007; Klahr & Simon, 1999). Another view sees science as a process of theory change and looks at the evidence that builds up against an established theory and pushes for change (Duschl et al., 2007). This view deals more with cognitive development and less with logic and reasoning (Duschl et al., 2007; Lehrer & Schauble, 2006). Yet another view sees science as a process of participation in the culture of scientific practices; this view is argued by social, cognitive, and developmental psychologists like Lave and Wegner who look at situated cognition (Duschl et al., 2007). This view focuses on the nature of scientific activity in laboratory settings, in real-world applications, and textbooks and acknowledges that scientific discovery is part of a larger social community rather than an individual or small-group endeavor (Duschl et al., 2007).

Science instruction has historically focused on students learning discrete facts in isolation which has caused them to develop misconceptions about the nature of scientific inquiry (NRC, 2012). NGSS listed eight science practices that can be categorized into three groups: investigating practices, sensemaking practices, and critiquing practices (NRC, 2012). The term "practices" was used instead "skills" to emphasize that engaging in scientific investigation requires both skill and knowledge that are specific to each practice (NRC Framework, 2012). There are eight science practices that NGSS considered essential for learning science and engineering in Grades K-12 (see Figure 2).

Figure 2

National Research Council of Eight Science and Engineering Practices

PRACTICES FOR K-12 SCIENCE CLASSROOMS
1. Asking questions (for science) and defining problems (for engineering) 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematics and computational thinking 6. Constructing explanations (for science) and designing solutions (for engineering) 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information

In Virginia's Science Standards of Learning, many standards begin with the phrase "Students will investigate and understand" (VDOE, 2018). The "investigate" and "understand" in the science standards demonstrates the parallels between Virginia's science standards and NGSS because both include the embedding of scientific and engineering practices into instruction to build and deepen conceptual understanding of core scientific ideas (VDOE, 2018). That phrase also communicates that students are expected to know or learn a range of scientific knowledge, skills, and practices to effectively investigate and understand the natural world around them (VDOE, 2018). The term *investigate* refers to a scientific methodology and implies that students will follow an inquiry process and utilize engineering skills as well (VDOE, 2018). The term *understand* refers to students' ability to apply scientific knowledge (VDOE, 2018).

Figure 3

Virginia's Inquiry and Engineering Skills

VIRGINIA'S INVESTIGATE and UNDERSTAND **Inquiry and Engineering skills**	
<u>Investigate</u>	**<u>Understand</u>**
1. Asking questions and defining problems 2. Planning and carrying out investigations 3. Interpreting, analyzing, and evaluating data 4. Constructing and critiquing conclusions and explanations 5. Developing and using models 6. Obtaining, evaluating, and communicating information	1. apply an understanding of key science concepts and the nature of science 2. use important information, key definitions, terminology, and facts to make judgments about information in terms of its accuracy, precision, consistency, or effectiveness 3. apply information and principles to new problems or situations 4. explain the information in one's own words, comprehend how the information is related to other key facts 5. think critically, problem-solve, and make decisions; 6. analyze the underlying details of important facts and principles, recognizing the key relations and patterns 7. arrange and combine important facts, principles, and other information to produce a new idea, plan, procedure, or product to solve problems.

Note. Adapted from Standards of Learning and the 2018 Science Standards of Learning Curriculum Framework, 2018.

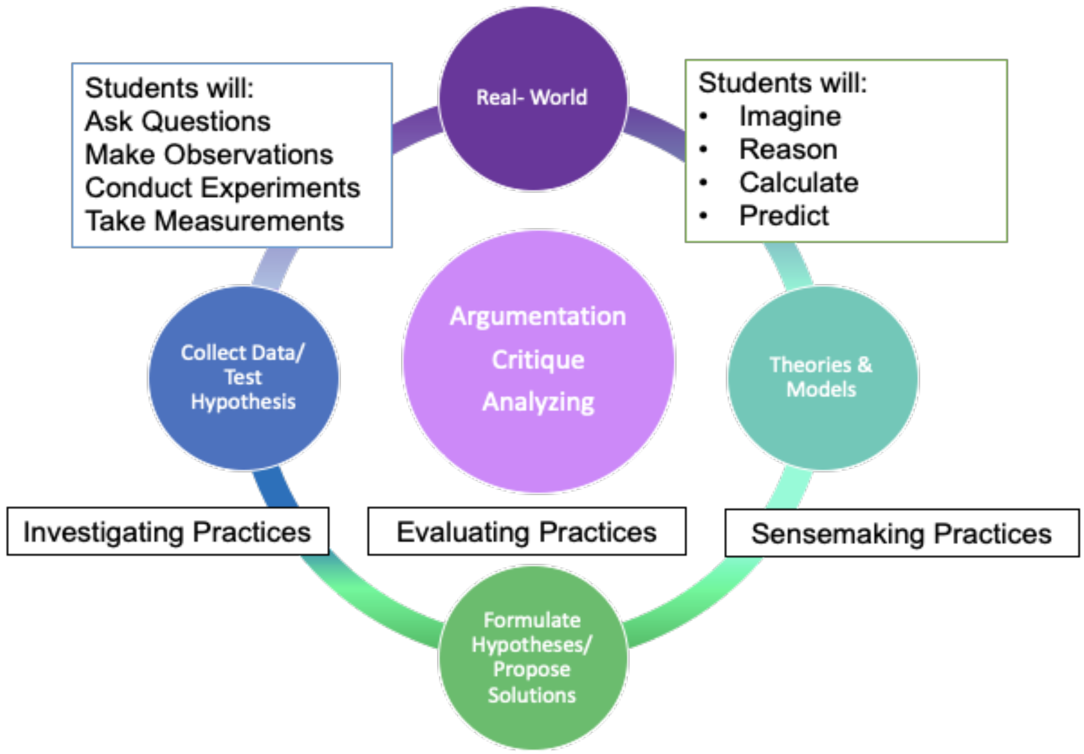
When science is taught as a set of practices rather than discrete skills, then the natural progression of learning is evident. Science practices show that developing a theory, reasoning, and testing are all part of a larger picture that also includes networking and sharing of information (Longino, 2002). Science also shows students a different way of writing, speaking, and representing their thoughts (Nercessian, 2008). Students using the lens of the nature of science see the work differently. They make observations and inferences, use scientific instruments correctly to gather data, and test their hypothesis through experimentation (Giere et al., 2006). In the K-12 science classroom engineering practices support science practices. It is not enough that students learn science practices, but engineering practices should be taught as well. These support students in understanding how science is used to investigate the world and engineering is used to build systems to improve the world.

Science and Engineering Practices

Scientific inquiry is the process through which science should be taught. Inquiry learning allows student ownership in the development of science practices (investigating, evaluating, and sensemaking) through the development and application of scientific and engineering practices (SEPs; see Figure 4). Unfortunately, due to a lack of agreement on the definition, elements of inquiry, and pedagogy, inquiry is not always used (Abd-El-Khalick et al., 2004). Inquiry requires students to identify what is known, classify assumptions, and use critical thinking to look for alternative explanations (National Institute of Health & National Institute of General Medical Sciences, 2004; NRC, 2000, 2012, 2015). “Science utilizes observation, experimentation, previous scientific knowledge, mathematics, and engineering technologies to answer questions about the natural world” (VDOE, 2018). “Engineering employs existing scientific knowledge, mathematics, and technology to create, design, and develop new devices or technology” (VDOE, 2018). When students use both scientific and engineering practices in the science classroom, they develop a deeper understanding of both disciplines and how they impact society (VDOE, 2018). The practices of science and engineering look at investigating, evaluating, and sensemaking as three spheres (see Figure 4). In the first sphere on the left, investigating practices, students are engaged in asking questions, observing, conducting experiments, and taking calculations (Schwarz et al., 2009). In the second sphere on the right, students are constructing designs or models using reasoning and creative thinking (Schwarz et al., 2009). The middle sphere is where explanations emerge based on the evidence; product designs are analyzed and results are argued and evaluated (Schwarz et al., 2009). This is an iterative process, and it repeats at every stage of the work for science and engineering.

Figure 4

Three Spheres Model of Science and Engineering Practices



Note. Adapted from the National Research Council Framework, 2012.

Investigating Practices

Investigating practices covers three of the eight practices for K-12 science classrooms: asking questions, planning and carrying out investigations, and using computational thinking (NRC Framework, 2012). Students must develop the skills to ask scientific questions about what they read, notice phenomena that they observe, and draw conclusions from models and scientific investigations (NRC Framework, 2012). Scientific questions can be driven by curiosity from the world, inspired by the need to solve a problem, or grounded in the findings from another investigation (NRC, 2012). The evidence that is gathered through an investigation is where the answers to the scientific are found (NRC, 2012). Asking questions and defining problems do not stop at the initial phase but extend to questions regarding data, claims, evidence, and the design of the investigation. It is important to realize that asking a question also leads to making an observation, and the ability to ask good questions is an essential skill for all students (NRC Framework, 2012).

Another science practice that falls under the investigating practices is planning and carrying out investigations. Students in Grades K-12 should be given opportunities to plan and carry out multiple investigations per year in their science classes. They should engage in investigations at all levels to answer a question posed by the teacher or to explore their own questions (NRC Framework, 2012). Scientific investigations are conducted to test a theory, describe a phenomenon, or model a process in the world (NRC Framework, 2012). When students are investigating, they need to state the purpose of the investigation, make predictions, and plan a course of action that will provide the best evidence to support their conclusions. Students are also required to identify components of their data such as the dependent and independent variables. The data collected are not considered evidence until they are used to support a claim (NRC Framework, 2012).

Students use reasoning and scientific theories to support their argument that data collected are evidence. In a controlled environment, such as a science laboratory, students test variables, collect data, and report their findings (NRC Framework, 2012). Field investigations or observations allow students to plan how to collect samples under various conditions and then collect the data from each sample. Students will use the final investigative practice, computational thinking, after planning and carrying out an investigation in the classroom or in the field (NRC Framework, 2012). In science, computational thinking is a tool that represents the physical variables and their relationships. These relationships are seen in statistical analyses of data, recognizing patterns, expressing quantitative data, finding patterns, and making correlations within the data. Computational thinking allows scientists to make predictions about the behavior of a physical system and to test those predictions (NRC Framework, 2012). Investigating practices engage students in asking questions and methods of data collecting (Duschl & Bybee, 2014). There are other practices that students engage in during scientific inquiry and these overlap with the others. These other practices can be grouped into sensemaking and critiquing practices.

Sensemaking Practices

Sensemaking practices involve analyzing and interpreting data and constructing explanations. These practices help students use data to explain the how and the why behind phenomena and to construct a model to show the process (McNeill et al., 2018). Analyzing and interpreting data helps students recognize patterns and relationships and make meaning of the data to communicate it to others (NRC, 2015). An analysis of data is where the meaning and the sensemaking is obvious. Data in their raw form often have little meaning, but after they are graphed, tabulated, or statistically analyzed, they can be used as evidence (NRC, 2015). Students are taught to create graphs and tables and to use spreadsheets and databases to organize their data (NRC, 2012). When students complete their high school education, they should be able to analyze data; recognize patterns in data; test their hypothesis using the data; create spreadsheets, databases, tables, charts, and graphs to display their data; explore relationships among variables; and evaluate conclusions based on the data set (NRC, 2015). Another sensemaking practice that students must be trained to use in the science classroom is the practice of constructing explanations and designing solutions.

The science practice of constructing explanations and designing solutions is important to provide a better understanding of the world. Scientific theories are developed to provide explanations of particular phenomena, allow inferences about past events to be made, and predict future events (NRC, 2015). A few examples are Cell Theory, the Big Bang Theory, and the Theory of Evolution. In science, students understand the difference between a theory and a law. Scientific theories are based on evidence and knowledge from credentialed scientists and can be revised as new evidence is discovered (NRC, 2012). The term hypothesis is often misunderstood; and referred to an educated guess; however, in science, it is a plausible explanation for an observed phenomenon that will be tested. Students need to develop the skill to construct scientific explanations to gain a better understanding of the scientific theories and natural phenomena around them (NRC, 2012). In science classes, students will find that there are several possible explanations for an observed behavior, and they must decide on the best one. This is done through a process called argumentation, which is part of the final category of NGSS science practices: critiquing practices.

Critiquing Practices

Critiquing practices involve engaging in argument from evidence and obtaining, evaluating, and communicating information. The critiquing practices focus on students' ability to evaluate different claims (Henderson et al., 2015; Sampson et al., 2013). Argumentation is settled based on the fit of the evidence-based explanation and the data, and the understanding and sensemaking that is an outcome (Sampson et al., 2013). Students struggle to evaluate the conclusions of others or often engage in argumentation without using evidence or use personal experiences as facts (Sampson et al., 2013). In the science classroom, there must be norms for discussing and holding students accountable for sensemaking practices. The teacher must create a culture for productive talk that supports the argumentation process. Students must feel comfortable expressing their ideas and providing receiving criticism from their peers about their work (McNeill et al., 2017; Sampson et al., 2013). Teachers must emphasize "how" as much as "what" in science classes; students need opportunities to practice and create scientific arguments and to have class discussions (McNeill et al., 2017; Sampson et al., 2013). These practices are key components to NGSS and Virginia's 2018 science standards. Scientists and citizens need knowledge and the ability to evaluate scientific arguments based on evidence (McNeill et al., 2017; NRC, 2012).

Scientific Literacy

Students must be literate in science, which includes the ability to read, understand, and communicate with others using words, diagrams, images, or graphs (NRC, 2012). Science reading is challenging for students for three reasons, even for those who are reading on grade-level: the vocabulary is unfamiliar and often uses passive voice and complex sentence structure (Mason & Hedin, 2011); text must be recorded to allow others to duplicate the work accurately; and science text requires students to read and communicate with texts, diagrams, charts, and mathematics (Mason & Hedin, 2011; NRC, 2012). The ability to communicate is a fundamental science practice and requires students to make observations with precision, record data with accuracy, and justify their argument with evidence (NRC, 2012; VDOE, 2018). The critiquing science practice includes the skill of reading and understanding scientific reports and is vital for students to learn to be productive citizens. Students should be taught to recognize credible science, whether they view it in the news, online, or see it presented (NRC, 2012). Early in a students' science education, they should be exposed to science communication and required to record and communicate their findings as well (NRC, 2012).

The eight science practices discussed guided the work of investigating administrators' perceptions of science instruction and the support of science teachers in the classroom. The aim was to better understand how administrators view and support science instruction and its alignment with current science practices in their schools. It is unknown how well administrators understand these science practices. If administrators do not have a clear understanding of the science practices that will not be able to identify or support their teachers in covering the new science standards for students in their building. Administrators will give science teachers feedback on what they perceive to be relevant science concepts, and this will lead to teachers and students not being prepared for the upcoming state science assessments that impact accountability for the school and the district.

Science Teachers and the Science Practices

The science practices in the NGSS and Virginia Science Standards of Learning reflect a vertical progression of content and practices that serve as a framework for teachers to meet science goals and provide students with opportunities to investigate and explore the natural world (NRC, 2012; VDOE, 2018). Research suggests that administrators are not prepared for the science reforms needed to achieve these goals and implement these practices at all levels (Trygstad et al., 2013). Many teachers may not have an integrated view of science instruction and believe that students should not participate in hands-on inquiry until after they have learned the content (Trygstad et al., 2013). Students are active thinkers who begin to construct their understanding from interactions with phenomena, the environment, and other individuals (National Institute of Health & National Institute of General Medical Sciences, 2004). This is based on constructivism, which recognizes that students need to express their thinking; interact with objects, organisms, substances, and equipment to have experiences; reflect on their thinking through writing; and make connections between their learning and the real-world (National Institute of Health & National Institute of General Medical Sciences, 2004). Some teachers' views of good science instruction involve the dissemination of concepts, facts, and laws without an explicit connection to a phenomenon or the real-world (McNeill et al., 2018; Roth & Garnier, 2006). Current science practices and standards require students to engage in the practice of science and to develop their understanding of science concepts (McNeill et al., 2018; Roth & Garnier, 2006).

Teachers may be concerned that they are unable to support students' learning of these science practices and content (McNeill et al., 2017). In the past, many teachers prioritized discrete science facts over science practices because that was the focus of state standards and assessments (Pimentel & McNeill, 2013). However, given recent changes to state science standards and assessments, teachers must engage students in science practices at every level (McNeill et al., 2018; NGSS, 2013; VDOE, 2018). It is not only the assessment and standards that drive science instruction for teachers. Another consideration is that teachers view good science instruction differently. Teachers may view science instruction as engaging students in activities that are fun and hands-on without having any concrete connection to eight science practices that should be the foundation of all students' science education (McNeill et al., 2018; Windschitl et al., 2008; Zembal-Saul, 2009). This addresses the area of teacher self-efficacy for science teachers. Teacher self-efficacy has been one of the few variables consistently reported to have a positive correlation with student outcomes (Savran & Çakiroglu, 2003).

The term self-efficacy was formalized by psychologist Albert Bandura who, through his research, noticed a mechanism that affected the belief that people have in their ability to influence the events of their own lives (Bandura, 1994). He called self-efficacy the mechanism for how people feel, think, and motivate themselves to produce at the level of performance they believe is needed to reach a goal or cope with challenges (Bandura, 1999). There are four main sources of influence on self-efficacy: mastery experiences, vicarious experiences, verbal persuasion, and emotional and physiological states (Akhtar, 2008). The most effective way of creating a strong sense of self-efficacy is through mastery experiences (Bandura, 1994). If teachers have low science teaching self-efficacy, they are likely to avoid teaching science practices or science at all in their classrooms (Joseph, 2010; Kinskey, 2018). The opposite is also true: if teachers have confidence in their science teaching ability, they will teach science (Joseph, 2010; Kinskey, 2018). Higher levels of self-efficacy have also been linked to teachers' willingness to implement curriculum reform (Cerit, 2013; Siciliano et al., 2017).

In science instruction the focus is shifting towards science practices; this is seen in changes in state and national standards as well as assessments. It is essential that teachers shift their focus as well and help students develop an understanding of the science practices earlier in their education (McNeil et al., 2018; NRC, 2012, 2015; VDOE, 2018). During the implementation of an educational reform, if teachers do not understand an aspect of a new policy, they are likely to ignore it (Coborn, 2001; Siciliano et al, 2017). One way to help teachers understand a new policy is through providing them a variety of opportunities to learn about the changes. A few examples are state webinars, state or district level professional development workshops, and school level collaborative team meetings. These professional or social networks will be examined in this study. A social network is an ideal place to lay a foundation that prepares teachers and administrators for change.

A look at social networks is needed because reform beliefs are not an individual process (Sicillano et al., 2017). School-based social networks have shown that an increase in teacher collaboration can lead to improved self-efficacy and student performance (Sicillano et al., 2017). Individuals add to their own beliefs and behaviors based on those of their social network (Siciliano & Thompson, 2015). Therefore, teachers' interpretation and adaptation of policy will form through social interactions at the school and district levels. The teachers' local school network that will have the most influence on their implementation practices (Coburn, 2001). Teachers need sufficient support in developing an understanding of these science practices themselves and strategies to teach the practices to their students (NRC, 2012; Trygstad et al., 2013). This support must come from their administrators, who must also have an understanding of the shift in science instruction and practices to support their teachers and students. There is little research on administrators' views or ability to support science instruction or recognize science practices in the classroom (McNeill et al., 2018).

Science and the Administrator

Successful implementation of science reforms requires investment from the various stakeholders involved (NRC, 2012). School-level stakeholders include teachers, students, counselors, and school administrators. School administrators' responsibility for instructional reforms has continued to increase in the last decade, which has resulted in a change of supports needed for classroom instruction (Darling-Hammond et al., 2007). Administrators have a responsibility to support all content areas regardless of their expertise and the various subject-specific needs within each discipline (Sergiovanni et al., 2013). The role of an administrator is vital to high-quality science instruction (Wenner & Settlage, 2015).

Unfortunately, very little is known about an administrator's capacity to support teachers in science (Halverson et al., 2011). Therefore, the focus of this chapter was on an administrators' understanding of the science practices, since the challenge for schools is implementing the NGSS

(NRC, 2012). Teachers need support in the form of ongoing professional development and strong instructional leadership from within their schools (Hallinger, 2005). The NGSS looks at how scientific knowledge is applied in different contexts and the ability to engage in science practices. Teachers require support to successfully integrate investigating practices, sensemaking practices, and critiquing practices into their instruction.

Conceptual Framework

Leadership Practices in School

School administrators matter for school, teachers, and student success. Numerous studies on the importance of school leadership have led to programs aimed at recruiting and preparing school leaders; however, this work originated from the effective schools' movement in the 1970s and 1980s (Hallinger, 2005; Hallinger & Murphy, 1985; Horng & Loeb, 2010). School leadership standards from 1996 have continued to evolve due to accountability legislation such as No Child Left Behind (NCLB) in 2001 and Every Student Succeeds Act (ESSA) in 2015. Both of these major pieces of legislation tied school leadership directly and inextricably to instructional leadership. Researchers and professionals worldwide have argued that school administrators should engage in instructional leadership (Ham et al., 2015; Shaked & Benoliel, 2020).

Instructional Leadership Historical Perspective

Instructional leadership is important, and it is second only to teaching when looking at school-related factors and their impact on student learning, but there is less consensus on what constitutes instructional leadership (Ham et al., 2015; Horng & Loeb, 2010; Leithwood et al., 2004; Liu & Hallinger, 2018). Instructional leadership was conceived as a curriculum-oriented role with duties that would be carried out by the school principal (Glasman, 1984; Hallinger &

Murphy, 1985). The definition of instructional leadership has evolved; it was once defined as the direct or indirect behaviors that significantly affect teacher instruction and student learning (Daresh & Playko, 1995). The definition now includes leadership, teaching, and student learning. There is a link between successful leadership and student learning: the greater the need, the greater the impact leaders' actions have on learning (Leithwood et al., 2004). As instructional leaders, school administrators must ensure that their teachers are trained in meaningful pedagogical practices (Senge et al., 2000).

Instructional leadership traditionally focused on supervision, staff development, and curriculum and instruction issues (Blasé & Blasé, 1999; Horng & Loeb, 2010; McKenzie et al., 2008). In a school, the historical ideal instructional leader would mentor their teachers through observations, feedback, and modeling good instruction when necessary (Horng & Loeb, 2010). However, in most secondary schools (especially large ones), course offerings are vast. Most school leaders do not have the content knowledge and relevant experience to provide mentoring for their staff in all subjects (Horng & Loeb, 2010). For example, a school leader who is a mentor could coach a new or poor-performing teacher on how to engage students in learning about World War II while offering another struggling teacher differentiation strategies for organic chemistry. Administrators who recognize that they must seek training and support to provide their teachers and students with what is needed are not in an abundance. Many believe that their administrative training has provided them with the skills needed to be successful instructional leaders. However, effective leaders take responsibility for leading their schools in rethinking goals, vision, priorities, pedagogies, learning resources, and assessment methods (Levine, 2011). They also design an environment where their teachers and students learn the skills needed to address critical changes (Senge, 1990).

Instructional Leadership Defined

Instructional leaders desire good instruction, but they must understand that good instruction rarely meets the needs of all students in the school (McKenzie et al., 2008). Teaching and learning describe a set of strategies that increase the effectiveness of meeting the needs of all learners (Darling-Hammond & Bransford, 2005; McKenzie et al., 2008; Zepeda, 2012). Those strategies are not always applied consistently with all students (McKenzie et al., 2008). Teacher quality plays a large role in student achievement, but school leaders also influence the school learning environment (Darling-Hammond et al., 2007; Marzano et al., 2005). Administrators are held accountable for school improvement and student achievement, which accounts for them being considered instructional leaders (Hallinger, 2005). The greatest need for instructional leadership is in schools where there are learning challenges; instructional leadership in high needs populations must be especially supportive to impact learning (Leithwood et al., 2006). The theories and frameworks discussed shaped the q-sort statements that were used in this study.

Strong instructional leaders define the school climate and demonstrate instructional actions. In a review of research on instructional leaders, (Leithwood et al., 2006) concluded that in the schools where leadership practices were presented and used with fidelity, students' achievement increased. The most effective leadership practices were where administrators shared their vision and believed their students could achieve at high levels, provided high-quality programs for their students, committed to their students performing well, valued research-based strategies, and were highly involved with providing instructional support to their teachers (Leithwood et al., 2004). The instructional leadership framework requires the school administrator to be engaged in the curriculum and instruction (Bush & Glover, 2014; Murphy et al., 2016). The research is clear: the quality of teaching is the strongest predictor of student achievement (Liu et al., 2018). In one study that look at student performance on reading and mathematics tests, the teacher affects student performance three times more than any other school factor, such as curriculum or student grouping (Darling-Hammond et al., 2017). An instructional leader mindset requires that the administrator has a purpose that focuses on promoting learning experiences and opportunities for all students (Kruse & Buckmiller, 2015; Shaked & Benoliel, 2020).

Instructional leadership is an educational leadership approach where administrators are involved in activities within the school aimed at improving teaching and learning for all students (Brazer & Bauer, 2013). In one study a link between administrators' instructional leadership to improved teacher practices and higher student performance across grade levels was established in public, private and charter schools (Shaked & Benoliel, 2020). Many researchers agree that instructional leadership should be a core responsibility of school administrators (Shaked & Benoliel, 2020; Thessin, 2019; Zepeda, 2012).

There are several frameworks used to study instructional leadership. The Hallinger and Murphy (1985) conceptual framework for instructional leadership was the earlier accepted framework (see also Hallinger & Wang, 2015). This framework looked at three dimensions of leadership roles: "defining the school mission, managing the instructional program, and developing a positive school learning climate" (Hallinger & Wang, 2015; Shaked & Benoliel, 2020). Most research on instructional leadership remains focused on prioritizing activities that deal with the quality of teaching and student learning (Hallinger & Wang, 2015; Murphy et al., 2016; Shaked & Benoliel, 2020). Another framework that focuses on the roles of an instructional leader is the Principal Leadership Development Framework (Hall et al., 2016). The Principal Leadership Development Framework emphasizes five key roles of the building administrator that are tied directly to instructional leadership: visionary, instructional leader, engager, learner, and collaborator. The administrator as a visionary communicates and leads the school through the process of implementing and revising the school's mission and vision. The administrator as instructional leader is responsible for building capacity of the staff through differentiated supervision, coaching, observational feedback, and evaluation practices and ensuring research-based best practices are used in instruction. The final three roles are the administrator as the engager, learner, and collaborator. These roles require the administrator to develop policies and practices that cultivate staff as reflective practitioners. The administrator as a learner and collaborator provides job-embedded learning opportunities to increase student achievement and develops leaders through an environment of distributed leadership (Hall et al., 2016). In order to have effective schools that influence student learning, a district must choose a framework that provides administrators with professional development opportunities for growth in all identified leadership roles (Hall et al., 2016).

Professional Standards for Educational Leaders

Some scholars disagree and view the role of an administrator as being more operational and managerial. The predominant practice is that school administrators are instructional leaders. This is seen in the 2015 Professional Standards for Educational Leaders, which were developed by the Council of Chief State School Officers and the National Policy Board for Educational Administration (2015). The new standards better reflect the evolving roles of school leaders and current research on educational leadership (National Policy Board for Educational Administration, 2015). Standards 6, 7, and 10 align best with the work of instructional leaders as curriculum, content, and capacity builders. Standard 6 looks at effective educational leaders as those who develop the professional capacity and practice of school personnel. Standard 7 looks to instructional leaders to create a climate of the professional community for their staff. Standard 10 regards administrators as change agents who are looking to continuously improve their school to promote student's academic success. One way to increase student academic success is to improve instruction. The school administrator influences teacher practice and student achievement in schools.

Providing Teacher Feedback

Administrators must understand high-quality instruction to support teacher practices through observational feedback. The administrator must understand science practices and have sufficient knowledge of the curriculum to know that appropriate content is being delivered to all students (Wahlstrom & Louis, 2008). The administrator must also be capable of providing constructive observational feedback to teachers to improve instruction (Wahlstrom & Louis, 2008). School administrators are in a position to influence the teaching and learning in their schools. An administrator's observational feedback is an important factor that influences a teacher's instructional practices (McNeill et al., 2018; Ovando, 2005). Administrators provide feedback within the evaluation process for teachers in numerous ways. One way is through formative evaluations, which are ongoing and designed to improve teacher performance (Lochmiller, 2016; Reinhorn et al., 2017). The formative evaluation process promotes teacher growth and helps the teachers become more effective (Lochmiller, 2016). Formative evaluations include classroom observations, classroom walkthroughs, teacher evaluation meetings, and teacher checklists (Lochmiller, 2016; Reinhorn et al., 2017). Administrators use these evaluation tools to provide teachers with strategies to improve instruction (Reinhorn et al., 2017; Wahlstrom & Louis, 2008). Summative evaluations are based on an administrator's professional decision on the overall quality of the teacher's performance over a period of time (Lochmiller, 2016; Reinhorn et al., 2017).

There are several ways administrators can provide teachers with observational feedback that leads to instructional changes. Three views are pertinent for administrators to consider when providing teachers with feedback: the micro view, snapshot view, and the long view (Brookhart & Moss, 2015). The micro view allows administrators to analyze their observational feedback to make sure it contains the characteristics that make for effective feedback. The snapshot view looks at the overall feedback to ensure that it supports learning. The long view is supportive of the feedback having an effect on a teacher's future practice and development (Brookhart & Moss, 2015). Without feedback teacher growth and development are unlikely to occur and needed instructional changes will not happen (Zepeda, 2012). Effective feedback from administrators promotes teacher self-efficacy, encourages goal-setting, includes concrete examples from the observation, and is timely and frequent (Zepeda, 2012). To provide meaningful observational feedback on classroom instruction, teachers expect the administrator to have some instructional knowledge and pedagogical skills (Zepeda, 2012). Constructive and meaningful feedback is needed from the administrator to promote self-reflection and lead teachers to a sense of self-efficacy in their teaching (Feeney, 2007). If administrators are going to move the teaching practice forward, then having meaningful and effective professional conversations regarding instruction is essential.

Instructional Leadership Concerns

Instructional leaders have a better opportunity to support teachers if the leaders are knowledgeable about the content they are supporting (Tsakeni et al., 2020). Content-area specific feedback is helpful for teachers and instructional leaders need to be knowledgeable about the teaching and learning challenges, pedagogies, and content (Diamond & Spillane, 2016; Tsakeni et al., 2020). Effective instructional leadership practices translate into improved learning outcomes (Heck & Hallinger, 2010; Tsakeni, 2020). Researchers who have studied instructional leadership theory across content areas, such as reading, mathematics, and science, have looked at the practical implications of leadership and what is required to improve specific learning areas (Fleisch et al., 2016; Fletcher et al., 2012; Tsakeni et al., 2020).

There are several reasons that school administrators do not engage in instructional leadership. Sometimes they become inundated with managerial tasks that keep them out of the classroom. Some administrators lack the required pedagogical content knowledge, skills, and disposition to engage in instructional leadership; this reason was a focus for this study (Carraway & Young, 2015; McNeill et al., 2018). Pedagogical content knowledge is the form of knowledge that is used by a teacher and the basis is helping students understand a science concept (Cochran, 1997). It is imperative that administrators understand pedagogical content knowledge in order to support their teachers, and when this is lacking that provides another reason administrators do not engage in the role of an instructional leader. Other essential characteristics of instructional leaders include daily focus on instruction, effective communication skills, ability to provide feedback to teachers, knowledge of instruction, and focused professional development (Carraway & Young, 2015). These duties often impede administrators' efforts to be effective instructional leaders. Administrators need support and training to be effective instructional leaders because most do not possess these characteristics (Bottoms & Schmidt-Davis, 2010; Carraway & Young, 2015). It is important to understand administrators' perceptions before implementing a program or seeking school reform (Carraway & Young, 2015).

Sensemaking Theory

In research studies, the strength of sensemaking is the use of participants' perceptions (Carraway & Young, 2015; Weick, 1995). It is the process for giving experiences context and making small details fit together and make sense (Carraway & Young, 2015; Evans, 2007; Weick, 1995). Administrators use sensemaking to make meaning of and respond to educational decisions like dealing with race and demographic change in their school (Evans, 2007). Sensemaking was also used in a more recent study that looked at school principals' predictions about the future of school principals (Reid, 2020). Sensemaking is influenced by social interaction with others because administrators often make decisions after discussing the matter with school leadership teams and others (Ancona, 2011; Carraway & Young, 2015; Coburn, 2005). School leaders draw upon their experiences to make decisions and interpret information; those experiences include professional development, knowledge, personal experiences, and training (Carraway & Young, 2015; Ingle et al., 2011). Though sensemaking is an ongoing process that school leaders undergo individually and collectively during reforms, not enough attention is given to the role of administrators as sense-makers. Schools are recognized as an organization that incorporate instructional leadership (Tsakeni et al., 2020). When organizations are studied through sensemaking it bridges the gap between theory and practice (Tsakeni et al., 2020). Sensemaking then becomes the lens to study the activities in a school and explore how administrators give meaning to their experiences (Weick, 1995; McNamera, 2015).

Sensemaking (Weick, 1995) refers to how people process the unknown and how others give meaning to their experiences (McNamara, 2015). Sensemaking involves creating a plausible understanding while acknowledging that people's experiences are evolving and ongoing (McNamara, 2015). Sensemaking enables school leaders to process what is going on in their environment and facilitate leadership through activities that will help teachers broaden their understanding. That is why it is imperative that school leaders have a vision and are able to share that vision with others (Ancona, 2011). Sensemaking is a predictor of successful leadership across multiple domains, but most leaders do not implement it into their organization (Ancona et al., 2020). Sensemaking has been used to qualitatively examine school leadership (Abrahamsen et al., 2015). It becomes a lens to study organizational activities by looking at how people give meaning to their experiences (McNamara, 2015; Tsakeni et al., 2020; Weick, 1995). Studies of policy reform and sensemaking show that individuals do not develop reform beliefs on their own, but seek out their peers to engage in discussions and formulate those shared understandings in their social networks (Coburn, 2001). Sensemaking, therefore, is a social and discursive process (Siciliano et al., 2017; Weick, 1995).

Sensemaking can be described as seeking, assigning meaning to, and acting on information (S. Seidel et al., 2017). This process provides the foundation for implementing sustainable practices (T. Seidel et al., 2011; S. Seidel et al., 2017). When an individual begins to “try to make sense” it usually starts with them noticing and drawing cues then labeling and categorizing (S. Seidel et al., 2017; Weick et al., 2005). This process allows the information to be streamlined and sorted into digestible portions in the mind. This sensemaking process is how common ground is found through experiences (Weick et al., 2005). Sensemaking with an organization helps individuals become aware of issues and notice the current situation so they can start to plan for change and act in an effective manner (Klein et al., 2006). The next step in organizational sensemaking is communication, which is an ongoing process that involves interactive talk so that a situation can be addressed with action (S. Seidel et al., 2017). Leaders engage in sensemaking to understand why and how a part of the organization is not functioning properly, and it can assist an administrator in understanding why they have not been as effective as an instructional leader as is needed (Acona, 2011). This process was used in focus group interviews and it occurred for the participants during their q-sort in the current study to understand how administrators perceived their observational feedback and support of secondary science teachers.

Summary

A conceptual framework to understand how to support and deliver effective feedback to secondary science teachers is a needed tool for school districts. There is evidence that administrators provide feedback to teachers in their buildings. However, whether administrators perceive their feedback as effective and have the capacity to support secondary science teachers is still unknown. The review of the literature in this chapter has identified and examined many of the instructional leadership elements needed to effectively support science teachers in the classroom. Chapter 3 will detail the planned methods of the study.

CHAPTER 3

Methodology

This chapter describes the approach used to answer the research questions. The purpose of this mixed-methods study was to examine administrators' perspectives of effective feedback and investigate how comfortable they are in providing support to secondary science teachers on instruction. This was an explanatory mixed-methods design that started with the collection and analysis of the quantitative data and was followed by qualitative data (Creswell & Clark, 2007). The qualitative data (post-sort interviews and questionnaires) were collected during the second phase as a follow-up to the quantitative results of the q-sort. The post-sort interview questions were based on the factors that emerged from the q-sort data collected. Only participants that were a part of the q-sort data were selected to participate in the post-sort interviews and questionnaires. This study began from a postpositivism stance during the quantitative phase and shifted to a constructivism stance for the qualitative phase (Creswell & Clark, 2007). Perceptions are subjective and formed by how information is organized, interpreted, and experienced. "Q methodology is a research method developed in 1935 by William Stephenson as a way to scientifically examine and quantify human subjectivity" (Brown, 1980; C. Brown & Militello, 2016). Qualitative techniques are often not generalizable and use surveys or a qualitative examination that provides an aggregate and relies on a large sample size for the data (Militello et al., 2016). Q Methodology does not require a large sample size and can provide insight on each factor group that emerges from the data.

The InQuiry research process combines the Q methodology to collect quantitative data on participant's subjectivity with the focus groups to gather qualitative data. The quantitative data indicate participants' perspectives while the qualitative data provide insights on their perspectives (Militello et al., 2016). InQuiry is a multistep assessment tool that seeks participant input at all stages of the study; stakeholders are fully engaged as participants during the data collection and as evaluators during the analysis of their beliefs (Militello et al., 2016). Participants engage in a sorting activity, then collaborate with like-minded groups to interpret the perspectives. The analysis examines why those perceptions exist in each participant. As shared perceptions are understood within a school district it will help to understand the actions, policy, and practice of those in leadership roles. InQuiry provides a measure to quantify individual perceptions that are elusive and idiosyncratic (Militello et al., 2016).

This chapter provides an overview of Q methodology and the overall research process. It then explores InQuiry as a tool for evaluation and concludes with a list of the Q statements used in the study.

Research Questions

The research questions that framed this study are:

1. What are secondary school administrators' perceptions of effective support and feedback to classroom teachers?
2. What do secondary administrators "notice" when watching science instruction?
3. How comfortable are secondary administrators at supporting and delivering effective feedback in science classrooms?

These research questions were designed to understand the elements necessary for successfully supporting science teachers and offering effective feedback to improve their instruction.

Rationale for Using Q Methodology

The Q Methodology and the InQuiry process guided this study. This process provided an opportunity to amplify participants' voices, which would be marginalized within large data sets using traditional quantitative methods (Bradbury & Reason, 2015, p. 42). Although similar to other methodologies such as Action Research, the Q Methodology differs in the data analysis process (Bradbury & Reason, 2015, p. 76). In Action Research, the practitioner identifies trends and sorts the patterns into categories (Sagor, 2000). However, in the InQuiry process, participant stakeholders actually conduct the sort and are asked to examine and discuss their responses (Militello et al., 2016). Participatory evaluation involves evaluation personnel and practice-based decision-makers within an organization working in partnership (Militello & Benham, 2010). It recognizes that knowledge is a social construct and that people give meaning to their lived reality by attaching meanings to their experiences (Yang, 2016). InQuiry achieves participatory evaluation “by fully engaging stakeholders as participants in the collection of individual beliefs and the subsequent analysis of their collective held belief” (Militello et al., 2016, p. 89). The purpose of this study was to explore a participatory process to examine selected administrators’ perceptions regarding effective support and feedback to classroom teachers.

Overview of Q Methodology

Q Methodology is a tool that allows the researcher to better understand the values, attitudes, and perspectives of the participants (S. Brown, 2006). There are several benefits to using Q methodology: it provides insight into viewpoints on issues, allows for the examination of sensitive topics from the participants’ perspectives, is participatory and engaging, and yields statistically valuable results (Militello et al., 2016). Q Methodology combines the strengths of qualitative and quantitative methods and bridges the gap between the two by including participants' opinions or perceptions; the analysis makes it an effective way to examine patterns and thoughts on a subject (Yang, 2016). This Q methodology study investigated the understanding of opinions and viewpoints of selected school administrators. Participants rank ordered a series of opinion statements about the specific topic (i.e., providing feedback to secondary science teachers) into a normal distribution grid. Responses were combined through factor analysis and participants were grouped with others who shared statistically similar perspectives. A Q methodology study has several phases. Phase 1 is developing the concourse; Phase 2 is selecting a sample of statements from the concourse to create the Q sample; Phase 3 is selecting participants who will make up the P sample; Phase 4 is facilitating the participants through the force distribution card sort known as the Q sort; and Phase 5 is performing the factor analysis and interpreting the findings (Militello et al., 2016).

The next step of the methodology, the InQuiry process, was developed by Militello and colleagues (2016). In this additional step, participants are interviewed to gain further insights into the rationale behind their decisions in the Q sort. This interview process allows participants to reflect and provides an opportunity for the participant to go through the sensemaking process. By using this reflective process that follows the Q sort, participants are guided through uncovering patterns and meaning in their own experiences that they might not have previously considered.

It is important for secondary science teachers and students that secondary administrators understand their perspectives on effective feedback and science practices to improve administrators' feedback and support of science teachers. With a better understanding, the professional development of administrators could be designed to increase their capacity to support science teachers and deliver more effective feedback to teachers to improve their instructional practices.

Phase 1 & 2 Concourse and Q Sample Development

Phase 1 and 2 of the Q Methodology are developing the concourse and selecting statements to create the Q sample. The statements the researcher develops to study a particular subject are called the concourse. These statements are generated from extensive literature reviews, interviews, and sometimes pilot studies (Militello et al., 2016). The statements for this study were generated from extant literature, reviews, and a survey sent to science teachers and administrators not included in the study. The survey asked teachers and administrators to list five support actions that an administrator had provided them or they as an administrator had provided a teacher to improve their instruction. After the concourse was developed, those statements are edited, combined, and refined to create a final list of statements known as the Q sample. The Q sample for this study was created with help from a group of teachers, professors, district leaders, and other educators. The Q sample group was asked to review the statements and provide feedback to improve the statements. This group checked to make sure the statements were worded clearly, combined similar statements, and removed any statements that were unclear, and suggested additional statements that needed to be added to the list (Militello et al., 2016). After a review from the educators' group, the Q sample was developed. The process was intended to work this way, but all meetings were virtual due to the impact of COVID and the school year being in a virtual status for several months.

Seventeen educators—including principals, assistant principals, lead teachers, district leaders, state leaders, and retired administrators—provided input on the statements. Three retired administrators, one district leader, and one state leader served as the pilot group and were asked to review the statements with the following questions in mind and to provide feedback to improve and narrow down the statements:

1. Are the statements worded clearly and are they understandable?
2. Are there any statements that should be combined?
3. Are there any statements that you would remove from the list? Why?
4. Are there any statements that you would add to the list? Why?

After the edits were made to the statements based on the recommendations from the pilot group, the final group of statements was loaded into the Q Method Software and two members of the pilot group underwent the q-sort and provided feedback. Several edits to the process were made, including the addition of a video that guided participants through each stage of the q-sort to ensure all participants could successfully complete the sort. The Q-statements are presented in Table 1.

Table 1

Effective Actions for Administrators Q-Sample Statements

Statement	Sources
Make suggestions and ask clarifying questions on my teachers' weekly lesson plans.	Pilot
Attend collaborative learning team (CLT) meetings with my teachers.	Survey: P1
Collaborate with teachers during the lesson planning process.	Survey: P1, P4
Conduct weekly observations and schedule timely follow up conferences.	Lochmiller, 2016
Schedule peer observations of other teachers.	Survey: P1
Partner with culture/climate coaches.	Survey: P3
Partner with curriculum specialists/supervisors.	Pilot
Conduct weekly constructive debriefs.	Reinhorn et al., 2017
Send my teachers appreciation notes as appropriate.	Brookhart & Moss, 2015
Use observation evidence in follow-up conversation.	Lochmiller, 2016
Offer opportunities for my teachers to demonstrate leadership or strength.	Hallinger, 2005 Survey: P3
Support teachers in the implementation of division initiatives.	Pilot
Encourage teachers to bring real-life examples/situations in the classroom.	Roth & Garnier, 2006 McNeill et al., 2018
Encourage teachers to provide students with opportunities to collaborate and engage in academic discourse.	Sampson et al., 2013
Expect teachers to move around the room to engage off-task learners, and re-engage them in the lesson.	Wahlstrom & Louis, 2008
Celebrate with my teachers over student growth and success.	Leithwood et al., 2004 Pilot
Encourage teachers to provide enrichment opportunities for their students.	Shaked & Benoliel, 2020
Encourage teachers to have positive teacher-student relationships.	Savran & Çakiroglu, 2003 Survey: P5
Require teacher-led instruction to ensure content is introduced to students as indicated in the pacing guide.	Survey: P13
Expect teachers to use technology and hands-on activities with students.	Windschitl et al., 2008 McNeill et al., 2018
Expect teachers to achieve higher than the division on common assessments and benchmarks.	Survey: P13
Encourage teachers to actively engage students in participation and discussion.	Duschl et al., 2007 Pilot
Encourage teachers to use a lot of hands-on activities utilizing student collaboration.	McNeill et al., 2018
Encourage teachers to use and share new technology and resources.	Windschitl et al., 2008 Survey: P10
Attend trainings on new technology.	Survey: P9
Provide targeted professional development based on evidence obtained from data and classroom observations.	Lochmiller, 2016
Emphasize the use of effective instructional practices to teachers.	Wahlstrom & Louis, 2008

Statement	Sources
Encourage teachers to reflect on their lesson plans and adapt based on student feedback from formative assessments.	Reinhorn et al., 2017
Ensure teachers provide formative and summative assessments to determine content mastery.	Reinhorn et al., 2017
Encourage teachers to use a classroom management system.	Finley, 2014
Encourage teachers to create an atmosphere of safety/trust in their classrooms.	Wahlstrom & Louis, 2008
Encourage teachers to set high expectations for all students.	Marshall, 2009 Survey: P11
Encourage teachers to provide feedback to students with suggestions for improvement.	Brookhart & Moss, 2015
Encourage lead teachers to facilitate collaborative learning in team meetings.	Survey: P2
Encourage teachers to take an active role in the implementation of the curriculum in my school.	Survey: P14
Expect teachers to follow the instructional pacing guide.	Survey: P15
Participate on the curriculum development team for the area that I supervise.	Wahlstrom & Louis, 2008
Conduct evaluations on my teachers beyond the division's expectations.	Reinhorn et al., 2017 Pilot
Attend professional development opportunities for content-specific areas.	Hall et al., 2016 Pilot
Use student data to help support my conversations with my teachers.	Survey: P12 NRC, 2015

Note. P = Participant; NRC = National Research Council

Phase 3 P Sample/Participants

Fourteen administrators participated in the post-sort questionnaires and focus group interviews. Table 22 displays the sub-group characteristics of the focus group participants. Six participants reported having taught science before becoming an administrator. Of the six participants who were former science teachers, five were former middle school science teachers and one was a former high school science teacher. The P sample is the group of participants who sorted the Q sample statements. For this study, the participants were secondary science administrators from an urban Virginia school district. There were 22 administrators included in the study. 7 of the 22 participants previously taught science prior to becoming an administrator. The other 15 administrators had different backgrounds. There were 5 administrators with an English or English Language Arts teaching background. There 3 administrators with a math teaching background. There were 3 administrators with a history or social science teaching background. The remaining administrators were 2 former physical education teachers, a former elementary teacher, and a former school counselor. The context of the study was a medium-sized urban school district in southeast Virginia. This study was useful to the current district and surrounding districts as they look to provide professional development for their administrators in supporting instructional leadership across content areas.

In order to ensure researcher bias was not a factor when looking at the perceptions of administrators, sensemaking theory was chosen as the conceptual framework because it would look at how the participants respond to the science clip and offer feedback on what they noticed. The study required administrators to first examine their perceptions about effective support actions, and then observe part of a science lesson and offer feedback based on their perceptions. Q methodology was an ideal research design for the study because it highlighted the existence of specific perspectives of those within the P sample. Generalizations can be made from the findings based on the Q methodology study techniques (Militello et al., 2016). For it to be a valuable study with manageable data analysis, a Q-methodology study must have fewer participants than statements (Watts & Stenner, 2012).

Phase 4 Q Sort

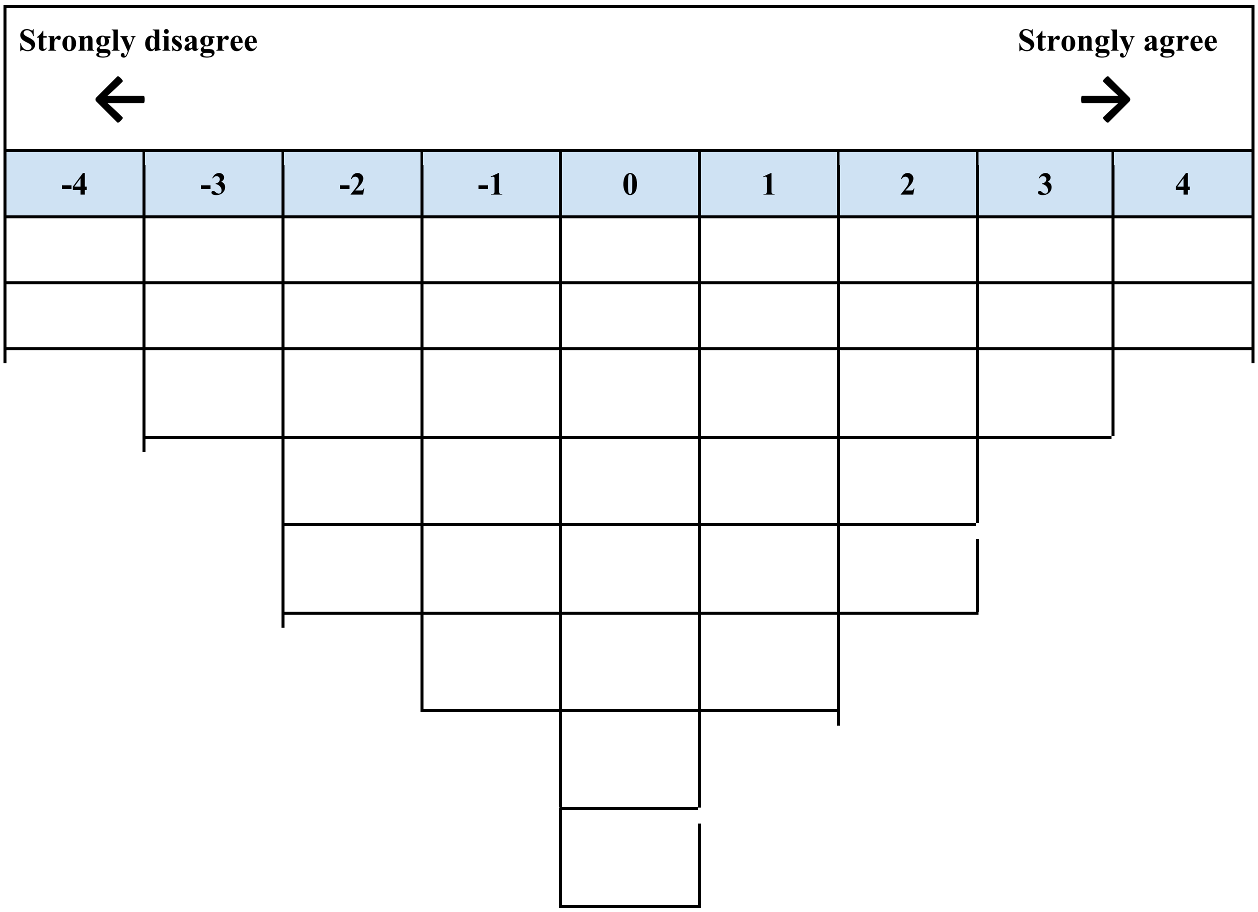
The Q sort is the phase in which participants (the P sample) sort the statements of the Q sample and rank order in response to a condition of the sort. The protocol for the card sort is included. (see Appendix A). Participants were informed that their participation was voluntary and completed a consent form (Appendix C) within the Q Method Software. If a participant declined to participate the screen thanked them for their time and the software closed. After signing the consent form, each participant as assigned a pre-coded unique identifier within the software. The master list of participant identifiers was not kept at the conclusion of the study. This study's condition of the sort was, “What are the most effective actions that I can take right now to help teachers improve instruction?” The statements from the Q sample were provided in a table. Participants completed the Q sort online.

Quantitative data was collected to capture administrators’ beliefs and perspectives about their instructional role and capacity to support teachers and students in secondary science classes. Quantitative data were analyzed using Q-Method Software (Lutfallah & Buchanan, 2019). The software was used to collect and compute variance, identify factors, and determine relationships between and among the participants using data from 22 Q-sorts. One of the advantages of the Q-Method Software was that it allowed participants to enter their responses to the q-sorts. Participants were shown the statements and instructed to select a thumbs up for statements that aligned with their views, a thumbs down for statements that did not align with their views, and a question mark for those statements that they felt neutral about. On the next screen they were asked to drag the statements down into the distribution grid.

They were asked to individually sort each statement into the grid with a forced-choice distribution. This distribution ranged from +4, where participants are asked to place statements with which they *Strongly Agree*, to -4, where participants are asked to place statements with which they S*trongly* D*isagree*. The blank sorting distribution is shown in Figure 5. The distribution shape includes 9 columns for the 40 statements. The distribution shape focuses participants to select those statements that they most agree with and those that they strongly disagree with on the ends and continue as they work their way to the statements that they are most neutral about in the middle.

Figure 5

Q Sort Distribution Grid



Phase 5 Factor Analysis

The quantitative data collected from the Q sort was analyzed using the Q-Method Software. The software was used to perform a by-person factor analysis to create a matrix that showed how each sort related statistically to other completed sorts. Factor analysis was used to determine the groups of participants with similar perspectives who would be contacted for post-sort interviews. Q methodology is a by-person factor analysis where response patterns are examined across participants rather than across variables (Militello et al., 2016). Ken-Q Analysis is a web-based application used to conduct factor rotations and matrix calculations as well. Z scores for each statement were compared to determine which statements participants valued more favorably. Factor arrays were used to create model sorts for each factor that represented that perspective. The factors emerged from each participant's feelings. Each factor's viewpoint was presented in a table following the analysis for that factor in an effort to illustrate the differences among the groups. All participants who shared the same view were categorized under one factor (Wint, 2013). For example, participants who strongly agreed with the statement "conduct weekly constructive debriefs" were grouped together. Each factor was then moved to the rotation period, which is referred to as a Varimax rotation. This was done to spread the viewpoints across the factors as evenly as possible and minimize the correlations between factors (Wint, 2013).

InQuiry Post-Sort Interviews

Participants showing similar perspectives based on the factor analysis were contacted for post-sort interviews. Participants from each factor were interviewed. These interviews produced qualitative data that were collected with selected participants. Participants were informed that their participation was voluntary and were given a consent form for this portion as well. Participants were grouped with others who shared similar perceptions. The participants were all from the same school district and part of a social network, which provided more insight when they were grouped together for interviews. Recall from Chapter 2 that individuals faced with new policies or unfamiliar situations seek out their colleagues for discussion to help reduce their uncertainty and provide the foundation for a social network (Siciliano et al., 2017). This portion of the study also relied on the sensemaking process because participants were grouped with other administrators based on their shared perceptions. Sensemaking is the process for giving experiences context and making details fit together into the bigger picture (Carraway & Young

2015; Evans, 2007; Weick, 1995). The participants needed to reflect on their past experiences to discuss how they sorted the statements, what they noticed in the science clip and how they would support the science teacher in the clip. Field notes were collected during the interview phase and were analyzed to look for common or shared perspectives. All interviews were recorded, transcribed, and thematically coded this process is called InQuiry (Militello et al, 2016). The transcripts and the questionnaires are reviewed for commonalities that might have led to a shared perspective. The statements are looked at and their relationships to one another that provided the basis for interpretation. Finally, the implications for the shared perspectives are reviewed. Participants were shown a model sort for their perspective and asked to respond to the post-sort questions shown on Table 2. The purpose of the follow-up interviews was to gain a deeper understanding of the underlying reasons for the participants' perspectives by engaging them in conversation to uncover facts and opinions not clearly identified in the q-sample.

Participants were asked about the statements placed in the *Strongly Agree* and *Strongly Disagree* columns as well as statements they felt were missing, easiest, and most difficult to place. Then they were asked about their perceptions regarding their role as the instructional leader and having to provide effective feedback for teachers. Administrators viewed a science clip that showed a middle school science teacher delivering a lesson on heat transfer via Zoom to their class. They were also asked to provide effective feedback for the science teacher in the clip. The purpose was to provide a better understanding of administrators’ capacity to provide effective feedback for secondary science teachers. All interviews were recorded, transcribed, and thematically coded. This process is called InQuiry and it was used to provide a qualitative account of participants’ perspectives (Militello et al., 2014). The focus group participants provided insights to answer Research Questions 2 and 3 (see Table 2).

Participants were given a link to complete their focus group consent form then asked to provide some demographic information (number of years as a teacher, subject taught, and number of years as an administrator), and finally asked to watch an 8-minute clip from a science lesson and provide details on what they noticed in the lesson. This was done to ensure that administrators were given ample time to review the video and provide their thoughts prior to the focus group interviews. The responses were discussed during the focus group interviews. The video focused on a physical science lesson on heat transfer. The teacher and students review the investigation they had conducted during the previous class. The teacher asked the students to give authentic examples of conduction, convection and radiation. The students were also asked to agree or disagree with their peers and to provide evidence for their statements. Field notes were collected during the focus groups and analyzed to document emergent themes and common perspectives. Individual and shared experiences and perspectives were identified through the data analysis process. Interpretations of participants' perspectives were based on both the qualitative and quantitative data collected. The administrators engaged in the sensemaking during the science clip when they were asked what they noticed and what feedback they would provide the teacher.

Table 2

Post-Sort Interview Questions and Research Questions Aligned

Research Question	Post-Sort Interview Questions
1. What are secondary school administrators' perceptions of effective support and feedback to classroom teachers?	1. Who is in your group? Describe any similarities and/or differences (e.g., demographics, job, etc.). 2. What has had the greatest impact on how you sorted your cards the way you did? (Examples- past experience, administration training, content knowledge, etc.). Please explain your answers. 3. Which statements best represent your shared perspective? 4. What name would you assign that represents the perspective illustrated by this model sort? Explain why and the meaning associated with that name—use statements to provide justification for your name.
2. What do secondary administrators "notice" when watching science instruction?	5. What did you "notice" during the science lesson?
3. How comfortable are secondary administrators at supporting and delivering effective feedback in science classrooms?	6. Based on your perceptions of the most effective feedback, what feedback would you provide to this teacher regarding science instruction? Do you feel comfortable delivering this feedback or support to this teacher?
All	7. Is there anything that was said that has triggered a different thought that would like to share?

Interview Coding

Inductive and deductive coding were used to address research questions of this study. In qualitative analysis, inductive reasoning involves reviewing raw data and condensing it into themes or categories based on inferences and interpretation (Zhang & Wildemuth, 2009). A top-down (deductive) or a-priori approach was also used based on the extant literature on science and engineering practices discussed in Chapter 2. The top-down (deductive) approach was used to address Research Question 2 where the code book was developed to guide the research team through the coding process. Also in Research Question 2, administrators shared additional data regarding, science instruction that did not fit the initial codes but needed to be addressed and that area was where the inductive coding occurred. It involved looking at the additional data from the post-interviews and questionnaires and condensing it into themes. That provided clear themes to categorize what administrators noticed about the science lesson they viewed. Research Question 3, which focused on administrator feedback based about they saw in the video and what constitutes good science instruction used the deductive coding process. Table 3 shows a codebook for the three identified science practices (investigating, sensemaking, and critiquing) aligned with administrators' responses to the science clip.

Table 3

Codebook for Science Practices

Practice	**Administrator Feedback**
Investigating	Asking questions regarding data, claims, evidence, and the design of the investigation. Planning an investigation Collecting data Conducting an experiment
Sensemaking	Analyzing or interpreting data Constructing an explanation Developing or using a model
Critiquing	Engaging in argument from evidence Obtaining, evaluating, or communicating information

Validity and Reliability

Q Methodology

Validity and reliability in Q-methodology is strengthened by repeating the direction of the Q-sort with each participant and finding similar factors from the analysis in Q-methodology

(Watts & Stenner, 2012). The content validity of the Q-sample is covered in the literature review and by including subject experts in the field in the pilot study. The q-sort statements were designed to ensure that each statement matched the correct theme as this would increase the internal validity and reliability of the research and provide a range of statements for the participants to select (Watts & Stenner, 2012). The balance of statements in the q-sort meant the different opinions of the administrators were represented (Watts & Stenner, 2012). Through piloting the statements more than once, the validity of the q-sort was increased, and can be used with confidence in future projects.

Post-Sort Interview Validity and Reliability

A research team was developed to ensure validity and reliability with the coding and development of themes. Research team members were not associated with the research project. The research team was used to reduce bias and improve validity and reliability. Only those codes and themes that were agreed upon by all members were used. Research team members included the following:

- Colleague in the doctoral program
- State science supervisor and Council of State Science Supervisors member (STEM co-chair)

The research team reviewed the data and reviewed the code book to ensure that everyone understood each code. The questionnaires were reviewed using line-by-line to code then there was a virtual meeting to discuss any statements or data that were not placed under the same code for all members. This process was also used for the post-sort interviews as well. Inter-rater reliability was established as the process looked at how many times the research team members confirmed the findings of each rater. Cohen's kappa coefficient was not used since all members of the team needed to agree for the code and the placement of the statement to be included. The science practices were used in the code book for research question 2 to ensure that those areas were addressed. However, the other data was obtained in post-sort interviews and questionnaires that led to the inductive coding process. That was where codes were created based on the noticings shared by the administrators. These codes led the research team to place them into a hierarchical coding frame based on how they related to the science practices to ensure the data uncovered was organized appropriately.

Ethical Considerations

Participants were provided with a video that included information about the study and consent information (which was the first step of the Q-Sort; all participants were required to complete it to move onto the next step). The informational video included the objectives of the study, measures to maintain confidentiality, and instructions for completing the Q-sort. This approach was a result of the COVID-19 pandemic, which caused widespread school closures. This study was conducted remotely, and I ensured that participants needed to meet with me only once to keep within the confines of the time allocation of the study. All participants who agreed to the interview portion completed an additional consent form that collected demographic information as well as their responses to the science clip. They were informed that they had the right to withdraw at any stage.

All participants were assured that their names would not be mentioned in the research and that their anonymity would be maintained through the use of codes. My dissertation chair and I were the only individuals with access to the recordings. After the research was completed, all recordings and data were stored securely in a password-protected site. The research will remain there until it is deleted in accordance with the policy of Old Dominion University.

Strengths and Limitations

The strengths and limitations for this study were related to the Q-methodology, during the data collection process and others during the interview, and analysis sections. The Q-methodology was ideal for exploration of participants' perspectives on their experiences and practices for supporting science instruction. The Q-method is organized, follows clear steps, and provides participants with a fixed distribution of the sorts. Several participants commented that they were required to go back and think carefully about their responses because they could only place two sorts in the +4 column and two sorts in the -4 column. The method showed the viewpoints of all participants. Results cannot be generalized due to the low number of participants, but that was not the goal of the study. The goal was to identify the viewpoints of the administrators. Another strength was that all voices were represented and that was seen in the results of the factors. The focus group interviews also provided the participants with an opportunity to share more about their perspectives in a group where they shared a viewpoint.

The main limitations were related to finding a suitable web-based software to conduct the Q-sort due to pandemic-related restrictions that required me to conduct the study in a completely virtual setting. This also impacted the number of participants that could participate based on challenges with understanding the unfamiliar software. Based on the feedback from the pilot study participants, I created an instructional video to address these challenges. The focus group interviews also presented a bit of difficulty getting administrators to agree on a time to conduct virtual focus group interviews.

Researcher Bias

Researcher bias is common in qualitative studies and in order to minimize confirmation, question-order, and wording question biases I used two research teams during this study. One team consisted of a central office administrator, a secondary science teacher, 2 retired secondary administrator supervisors and a retired deputy superintendent. This group was chosen for their unique areas of expertise and their perspectives related to secondary administrators. This group reviewed the interview questions to ensure that they were appropriate, specific, and open-ended. The questions were worded in a clear manner and all redundant questions were removed prior to the focus groups. The second team consisted of a state science supervisor and a colleague of the doctoral program. The second team and I reviewed the data obtained and analyzed to minimize bias.

Subjectivity Statement

A researcher's personal experiences can potentially influence the interpretations and meaning derived from data collected in a research study. The purpose of this subjectivity statement is to provide the reader with some background information on my experiences and viewpoints. This is my 19th year in education in Virginia. I have worked in public education during this time in urban, rural, and suburban settings. I have been a secondary science teacher, gifted specialist, instructional specialist, science coordinator, and a science director. In my current role as a science director for my district, a primary focus of my work has been providing science teachers effective feedback and support and working with administrators on improving science instruction in their schools. My goal in conducting this research is to gain an authentic understanding of secondary administrators' perceptions of effective feedback and support for teachers, specifically science teachers. The outcome will hopefully lead to district support for subject-specific secondary administrators at the secondary level.

Summary

This chapter presented an overview of the InQuiry process and Q methodology. The rationale of the methodology and the research design was discussed, and the procedures were described. The InQuiry research process includes the development of the Q and P samples, conducting the Q sort, the post-sort interviews, and data analysis. Procedures and implementation of Q-Method and InQuiry processes were also discussed. Ethical considerations were identified and justified, and strengths and limitations of the study were covered. Researcher bias and subjectivity comprised the final part of this chapter. Chapter 4 presents the findings of the study.

CHAPTER 4: FINDINGS

The purpose of this Q-Methodology and InQuiry study was to identify and explore the relationship between the structure and focus of an administrator's instructional roles and their capacity to provide meaningful feedback for secondary science teachers. The analysis process for Q-Methodology takes each participant's perspective and compares it with all other participants' Q-sort results. The Q-Method Software was used to conduct the process (see Chapter 3). The software showed the results as seven factors, which were then reduced to the best solution for this study's data, three factors. Three factors meant that the participants were divided into three groups, where each factor encompassed all participants who were found to have similar perspectives towards the statements. The demographic information was also linked in the interpretation stage of the data analysis specifically the subjects the administrators taught. A summary for each factor was presented to the participants at the beginning of each focus group interview. The post-sort questionnaire responses and focus group interviews were analyzed and linked with the Q-statements in an effort to highlight the relationship between the responses and the administrator's perspectives. The focus group interviews also addressed Research Questions 2 and 3.

Table 4 shows how the research questions fit into the data collection process. The study was also designed to examine what administrators notice during science instruction and examine specific support they would offer a secondary science teacher based on the observed lesson. School leaders desire to provide teachers and students with meaningful experiences that will result in an improvement in instruction and students' college and career readiness. The mixed-methods study was designed to answer the research questions directly related to the perceptions of secondary administrators and their capacity to recognize and support quality science instruction.

All participants stated that they felt varying levels of frustration because they were only permitted to select two statements that captured their perspective the most (*Strongly Agree,* +4), and then they went on selecting the next ones that they felt were statements that they identified with strongly and continued until they reached neutral (*Neutral,* 0) statements. On the other side of the distribution grid, they had to repeat the process for those statements that they identified with the least (*Strongly Disagree,* -4). Responses from the post-sort questionnaire and focus group interviews provided qualitative data to deepen understandings of the numerical results. The subjective opinions from participants were used to name and describe each factor.

Table 4

Research Questions and Data Sources

Research Question	**Source**
1. What are secondary school administrators' perceptions of effective support and feedback to classroom teachers?	Extant Literature review Q Statement development Pilot study Q sort
2. What do secondary administrators "notice" when watching science instruction?	Post sort questionnaire Focus group interviews
3. How comfortable are secondary administrators at supporting and delivering effective feedback in science classrooms?	Post sort questionnaire Focus group interviews

Factor Extraction and Rotation

Intercorrelations among the Q-sorts were examined to look at the relationship between each individual Q-sort with every other Q-sort, which are then factor-analyzed to produce factor groupings of the participants with that specific viewpoint that was shared. Prior to the factor extraction, I decided to use the Centroid method (preferred for Q-Methodology), which allows the factors to be rotated, unlike the Principal Method. The rotation of the factors enabled the explorations of the data until a solution was decided upon which allowed for a richer and more informative account in this study. The Centroid method was used to extract seven factors (the maximum number of factors that can be extracted by the software). The seven-factor solution is a starting point and was used in the study (Watts & Stenner, 2012).

The Q Method formed seven unrotated factors done with the Centroid Method in the program. Table 5 shows the factors extracted and unrotated loading of each Q-sort with that factor, along with the eigenvalues and explained variance by each factor. The next step was factor rotation. The goal of rotated factors was to “get the viewpoint of the various factor suitability focused in relation to the data collected” (Watts & Stenner, 2012, p. 42). The purpose of the rotated factor is to make the interpretation of the factor easier. I selected the Varimax rotation technique because it provided a simple solution based on statistics and reduced the possibility that I would impose any subjectivity onto the results (Wint, 2013).

Table 5

Extracted Unrotated Factors Using Centroid Factor Analysis

	Factor						
Participant	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1	0.3027	0.1699	-0.0789	-0.0073	-0.3221	0.0700	0.2438
2	0.1913	-0.1056	-0.3177	0.2849	-0.1255	0.1110	0.1451
3	-0.1256	0.3794	0.1282	-0.0796	0.3041	-0.1360	0.2240
4	0.6404	0.1262	-0.1229	0.1276	0.0392	0.0261	0.2229
5	0.2408	0.3389	0.2586	0.2435	-0.1405	0.1236	0.0084
6	0.4895	-0.2066	0.2739	0.1086	0.1411	0.0691	-0.1567
7	0.6093	-0.3484	0.2672	0.2397	-0.0499	0.1191	0.1491
8	0.2379	-0.1910	0.3116	-0.1259	-0.0388	0.0724	0.0795
9	0.5528	-0.3171	-0.0471	0.0703	0.0364	0.0562	0.0098
10	0.4337	0.2364	0.1387	-0.4403	-0.1194	0.1633	-0.0952
11	0.5961	0.3274	-0.1769	0.1511	0.0908	0.0934	-0.1524
12	0.8288	0.0253	-0.1980	-0.2325	0.0450	0.0638	0.0206
13	0.6055	0.1716	0.0236	0.1855	0.0537	0.0300	0.1872
14	0.5179	-0.2272	0.1557	-0.1349	0.2946	0.1005	0.1013
15	0.6226	0.4156	0.0064	-0.0615	-0.1240	0.1026	0.1330
16	0.5049	0.1234	-0.2401	-0.0135	0.2463	0.0831	-0.4030
17	0.3991	-0.1727	0.0904	-0.0654	-0.3033	0.0635	-0.2306
18	0.4106	-0.2224	-0.2218	-0.2596	0.1480	0.1180	0.2137
19	0.5254	0.0672	0.0284	-0.2336	0.0079	0.0370	0.0129
20	0.4222	-0.2571	-0.3625	-0.1694	0.1432	0.1540	-0.1150
21	0.5043	0.2003	0.2854	0.2823	0.3169	0.1544	0.0342
22	0.7629	0.2214	0.1117	0.0257	-0.0700	0.0297	-0.2208
Eigenvalues	5.7112	1.2874	0.9070	0.8158	0.6885	0.2147	0.6539
% Explained Variance	**26**	**6**	**4**	**4**	**3**	**1**	**3**

Two different statistical programs were used for the analysis of the Q-sort data. Q Method Software and Ken-Q Analysis were used to verify the findings in this study. The Q Method Software was used to conduct the study with the participants and analyze the data. The Ken-Q Analysis software was used to analyze the data and to extract 8 factors because it could not be realized in the other software. A Scree Plot was created using the Ken-Q Analysis software; however, all other analyses showed the same findings.

Correlation Matrix

Principal component analysis was used to find associations (a correlation matrix) among the different Q-sorts (McKeown & Thomas, 2013). The analysis of the correlation matrix quantifies the relations between any two sorts (Watts & Stenner, 2012). A necessary step toward the generation of a factor matrix was to establish a relationship between each sort. The matrix for the study measures 22 X 22, based on the number of participants. A truncated version of the correlation matrix is presented in Table 6. Correlation coefficients range from -1.0 to +1.0. A correlation of +1.0 indicates an identical match, with all sorts placed in the same column. A correlation of -1.0 indicated an opposite match between participants with all sorts placed in the opposite column as the reference sort. For example, Participant 11 had relatively high correlation matrix sort values with Participant 12 of 0.54, indicating some similarity with each other. Participants 11 and 12 are both represented by Factor A. Conversely, Participant 3 and Participant 16 had a correlation matrix sort value of -0.05, reflecting minimal similarity between their sorts. Participants 3 and 16 are not represented within the same factor.

Table 6

Correlation Matrix between Sorts (Truncated)

Sort	1	2	3	...	20	21	22
1	1	0.15	-0.14	...	0.09	0.09	0.24
2	0.15	1	-0.15	...	0.19	-0.1	0.19
3	-0.14	-0.15	1	...	-0.25	0.04	0.01
...	...	...	...	...	...	...	...
20	0.09	0.19	-0.25	...	1	0.05	0.26
21	0.09	-0.1	0.04	...	0.05	1	0.38
22	0.24	0.19	0.01		0.26	0.38	1

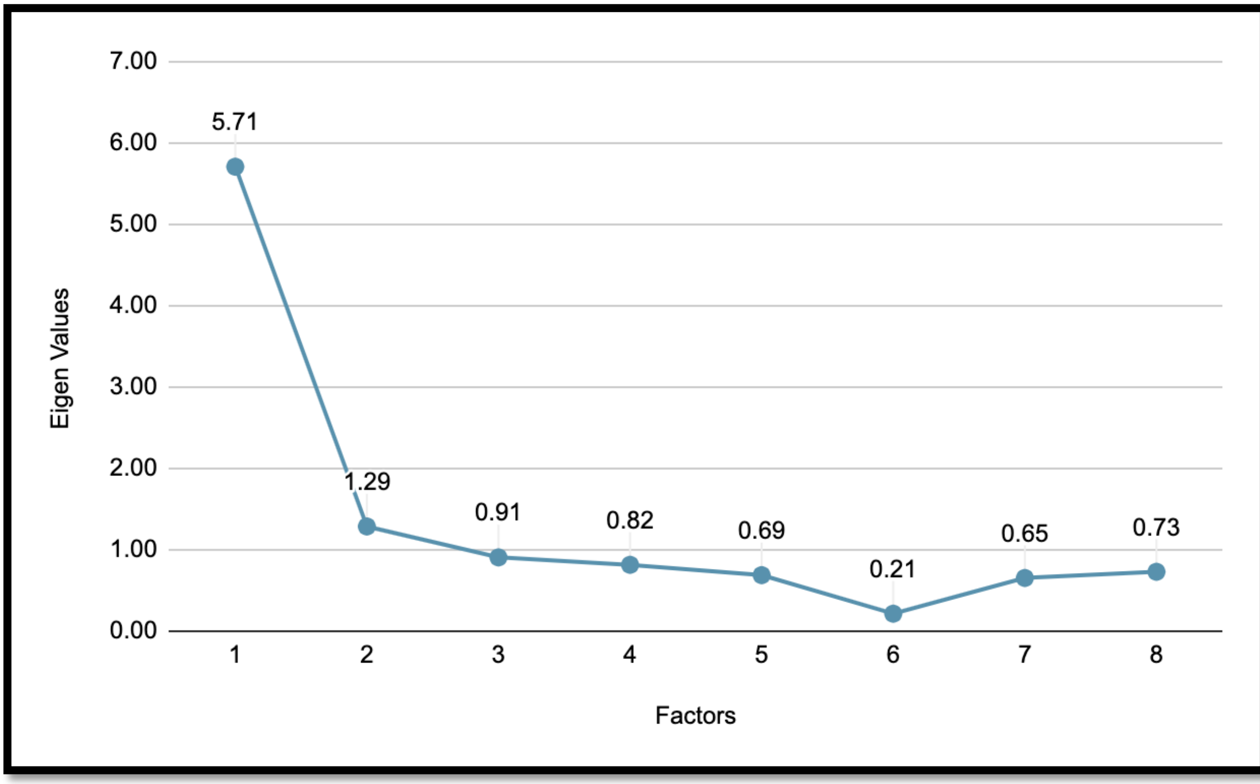
Weighted averaging is used to calculate statement scores, the statement scores indicate the level of agreement and disagreement that each statement receives within each of the identified factor groupings. When all participants have completed the q-sort, the statements are arranged in order of descending scores. This is referred to as a *model q-sort* for each factor. To examine a comparison between factors, the statement scores (+4, +3, -1, -2 etc.) are examined in the original sorting process. The comparison of statement scores across the groupings of participants with similar opinions (factors) are how the groups are formed. Particular attention was given to those statements that helped distinguish between factors and those statements that received extreme scores at either end of the sorting continuum. Post-sorting questionnaires and focus group interviews were conducted to confirm the researcher's interpretations.

Factor Analysis

In Q-methodology, data analysis uses correlation and by-person factor analysis; the statistical analysis was not performed by variable, trait, or statement, but rather by person. Q Methodology examines data holistically by looking between participants rather than making a comparison of how individual statements were sorted by the participants (Watts & Stenner, 2012). Participants correlate to others with similar opinions based on their Q-sorts. Analysis reveals the grouping of expressed opinion profiles based on the similarities and differences in the statements that were arranged by each participant. When highly correlated Q-Sorts are clustered together, a similarity emerges that is named a factor. The factors were named based on the statistical characteristics of the highly ranked statements, common themes that emerged from the post-sort survey questions, and the focus group interviews.

Figure 6

Scree Plot of Eigenvalues



Note. The Scree Plot was done to produce a solution for 8 unrotated factors to ensure the correct number of factors was selected.

The Q Method analysis produced a solution with seven unrotated factors. Ken-Q Analysis produced a solution with eight unrotated factors. Participants having similar viewpoints were clustered together. A higher eigenvalue is achieved when more participants are loaded on that factor (Damio, 2018). This represents an important viewpoint of the issue at hand. The eigenvalues of all eight factors were examined to help determine where a noticeable difference existed between the factors. A scree plot of the eigenvalues is shown in Figure 6. The eigenvalues were analyzed for factor strength and a distinct elbow formed after Factor 1. Q methodology studies with a single factor do not produce robust results and in these results, a single factor solution did not represent a large enough variance to exclude rotating other factors.

The purpose of Q Methodology was to extract multiple distinct viewpoints from the participants. Several different rotated factors solutions were explored to see which of them was significantly loaded by the participants. A two-factor solution accounted for 32% of the variance among the sorts and included 21 of the 22 participants ($p < 0.05$). Under the two-factor solution, the factors all had correlation values of 0.5 or greater, indicating relative similarity between factors. The three-factor solution increased the variance level to 36% among the sorts and included 21 of the 22 participants. The correlation between factors decreased as a distinct factor emerged having correlation values of 0.48 and 0.25 with the other factors. Three consensus statements were identified with the three-factor solution.

A four-factor solution accounted for 40% of the variance among the sorts and included 18 of the 22 participants $p < 0.05$). The correlation between factors decreased as the consensus statements remained the same as the three-factor solution. A three-factor solution was selected because it offered the best balance between high values for included variance, the inclusion of more participants, lower values for correlation among factors; this solution represented a point of consensus statements. The three-factor solution had only one confounding load (P9), which was a participant who met the 0.05 confidence threshold for Factors B and C. The confounding load participant was placed into Factor B, with which they had the highest correlation. That was done to ensure their viewpoints were represented. P3 did load onto Factor 3, but loaded with a negative value, which meant that was an inverse opinion to that factor. Table 7 shows the key variables used to select the number of factors.

Table 7

Information Used to Determine Factor Rotation

Factor Rotation Solution	**Eigenvalue**	**Explained Variance**	**Participants (N = 22)**
2	5.71	32%	21
	1.29		
3	5.71	36%	21
	1.29		
	0.91		
4	5.71	40%	18
	1.29		
	0.91		
	0.82		
5	5.71	43%	18
	1.29		
	0.91		
	0.82		
	0.69		

The table of correlation values among factors for the three-factor solution is shown in Table 8. Lower values for the correlation among factors indicated more distinct factors. As shown in Table 8, Factors A and B are the most statistically similar factors, with a correlation of 0.4791, while Factors A and C are the most statistically distinct, with a correlation of 0.247.

Table 8

Correlations Among Factor Scores

Factor	Group		
	A	B	C
1	1	0.4791	0.247
2	0.4791	1	0.2596
3	0.247	0.2596	1

Factor Loadings

The initial factors were rotated with the Varimax method. This method of factor rotation was used because it attempts to clarify the relationship among factors. It maximizes the amount of variance shared among extracted factors (Watts & Stenner, 2012). The rotated factors represent 36% of the variance, with Factor A representing 26%, Factor B representing 6%, and Factor C representing 4%.

A correlation score was calculated for each participant. The correlation score is a measure of association between the Q sort of each participant and the model factor array that statistically represents a factor. Table 9 details how each participant loaded onto the factors. The correlation score required to indicate significant loading on a particular factor is proportional to the value of the $1/\sqrt{n}$, where *n* is the number of statements in the study. The z critical value at 95%

confidence level is 1.96; at 99% confidence level it is 2.58. The 0.05 significance level was calculated by $1/\sqrt{40} * 1.96 = 0.310$. The 0.01 significance level was calculated by $1/\sqrt{40} * 2.58 = 0.408$. All participants except Participant 3 in this study loaded significantly on a factor at the 95% confidence level, shown on Table 9; 21 participants loaded significantly on a factor ($p < 0.05$). Additionally, 18 participants met the criteria to load significantly on a factor at the $p < 0.01$ level.

Table 9

Factor Matrix Using Participants' Q-Sorts (Loadings)

Participant	**Factor**		
	1	**2**	**3**
1	0.3409**	0.0214	0.1001
2	0.0831	-0.0383	0.3745*
3	0.1587	-0.1966	-0.3352
4	0.5616*	0.2016	0.2917
5	0.3950**	0.1077	-0.2685
6	0.2082	0.5536*	0.0863
7	0.2203	0.5058*	0.1993
8	0.1727	0.3698**	0.1753
9	0.1940	0.4462*	0.4142
10	0.4727*	0.1936	-0.0479
11	0.6674*	0.0325	0.2174
12	0.6351*	0.3124	0.4751
13	0.5602*	0.2502	0.1421
14	0.2007	0.6929*	0.2090
15	0.7386*	0.1140	0.0432
16	0.4652*	0.0554	0.3291
17	0.0322	0.4317*	-0.0519
18	0.1612	0.2062	0.4458*
19	0.4305*	0.2671	0.1571
20	0.1524	0.1427	0.57638*
21	0.4938*	0.3446	-0.1153
22	0.7058*	0.3641	0.1131
% Explained Variance	**26**	**6**	**4**

*$p<0.01$
**$p<0.05$

On Factor A, 12 participants loaded significantly. On Factor B, five participants loaded at a level of statistical significance. Factor C had three participants who loaded significantly. Participant 9 was a confounded load, which means they loaded significantly on more than one factor. Participant 3 loaded negatively onto a factor. The participant with a confounded load was included with Factor B group because the score was 0.4462 for Factor B and 0.4142 for Factor C. Participant 3 loaded higher on Factor B and was included with that group. The other participant with a negative load exhibited an inverse viewpoint to the factor that they loaded on (Watts & Stenner, 2005). Based on the content background of the participants the expectation would be that those with a science background would load onto the same factor. The majority of the administrators with a science background loaded onto Factor A. The three factors that emerged from the data analysis consolidated the 40 statements and 22 participants into three perspectives. Each factor produced a model array, which was a statistically representative sort of the participants who shared that perspective. The placement of each statement across all factors on the continuum of the most representative (+4) to the least representative (-4) in the model factor array is presented in Table 10.

Table 10

Statements and Fact Placements

Statement	Factor		
	A	B	C
Make suggestions and ask clarifying questions on my teachers' weekly lesson plans.	-3	-1	-3
Attend collaborative learning team (CLT) meetings with my teachers.	-2	3	2
Collaborate with teachers during the lesson planning process.	-2	2	0
Conduct weekly observations and schedule timely follow up conferences.	-1	-1	4
Schedule peer observations of other teachers.	-2	-2	0
Partner with culture/climate coaches.	-2	-4	-3
Partner with curriculum specialists/supervisors.	0	1	-1
Conduct weekly constructive debriefs.	-4	-3	2
Send my teachers appreciation notes as appropriate.	-3	-2	-2
Use observation evidence in follow-up conversation.	1	0	3
Offer opportunities for my teachers to demonstrate leadership or strength.	-1	-2	-2
Support teachers in the implementation of division initiatives.	1	1	-3
Encourage teachers to bring real-life examples/situations in the classroom.	2	0	0
Encourage…opportunities to collaborate and engage in academic discourse.	2	-1	1
Expect teachers to…engage off-task learners and re-engage them in the lesson.	1	0	-1
Celebrate with my teachers over student growth and success.	0	0	2
Encourage teachers to provide enrichment opportunities for their students.	0	-1	0
Encourage teachers to have positive teacher-student relationships.	4	4	0
Require…content is introduced to students as indicated in the pacing guide.	0	-1	-4
Expect teachers to use technology and hands-on activities with students.	2	0	1
Expect teachers to achieve higher than division on common assessments/benchmarks.	-1	-2	0
Encourage teachers to actively engage students in participation and discussion.	4	1	1
Encourage teachers to use a lot of hands-on activities utilizing student collaboration.	3	-1	-2
Encourage teachers to use and share new technology and resources.	0	-2	1
Attend trainings on new technology.	-1	-4	-4
Provide professional development based on evidence…and classroom observations.	0	2	0
Emphasize the use of effective instructional practices to teachers.	1	1	1
Encourage teachers to reflect on lesson plans/adapt based on…formative assessments.	1	0	3
Ensure…formative/summative assessments to determine content mastery.	2	3	1
Encourage teachers to use a classroom management system.	0	1	-1
Encourage teachers to create an atmosphere of safety/trust in their classrooms.	3	2	-1
Encourage teachers to set high expectations for all students.	2	4	2
Encourage teachers to provide feedback to students with suggestions for improvement.	3	0	0
Encourage lead teachers to facilitate collaborative learning in team meetings.	-1	1	-2
Encourage teachers take active role in implementation of curriculum in my school.	-1	3	-2

Statement	Factor		
	A	B	C
Expect teachers to follow the instructional pacing guide.	0	2	2
Participate on the curriculum development team for the area that I supervise.	-4	-3	-1
Conduct evaluations on my teachers beyond the division's expectations.	-2	-3	4
Attend professional development opportunities for content-specific areas.	-3	0	1
Use student data to help support my conversations with my teachers.	1	2	3

Note. Some statements truncated for readability. See Table 1 for full statements.

Humphrey's Rule is an additional test on the strength and statistical validity of the factors that was applied. The test compares the two highest loadings on a factor to twice the standard error. "Humphrey's Rule states that a factor is considered significant if the cross product of the two highest loadings exceeds twice the standard error (1/√number of statements)" (Brown, 1980, p.223). All of the factors in this study satisfied Humphrey's Rule, which reinforces the selection of a three-factor solution (see Table 11).

Table 11

Humphrey's Rule

	Factor		
Solution	**A**	**B**	**C**
Cross Product of Two Highest Loadings	0.632	0.158	0.115
Standard Error	0.050	0.050	0.050
Standard Error x 2	0.100	0.100	0.100
Difference	0.532	0.058	0.015

Factor A: Effective Encouragers

Twelve participants loaded significantly on Factor A. This accounts for 55% of the participants and 26% of the variance. Table 12 displays the sub-group characteristics of the participants who loaded significantly on Factor A. Five were science teachers. Two taught fewer than 5 years in the classroom. Ten taught 5 or more years in the classroom. Four had been an administrator fewer than 5 years; the remaining eight had been an administrator for longer than 5 years. There were five White and seven African-American administrators in Factor A. Four participants in Factor A were male and eight were female. The highest loading participant (P15) reported teaching for 10 years and being an administrator for 18 years. The next three participants reported teaching for 5 years or fewer and being an administrator for more than 10 years each.

Table 12

Participants Loading Significantly on Factor A

Participant	Loading	Race	Gender	Subject	Years Taught	Years as Administrator	Highest Degree
1	0.341	W	M	History	14	3	Ed.S
4	0.562	AA	F	ELA	7	8	M.A.
5	0.395	W	F	Science	16	1	Ed.S
10	0.473	W	M	P.E.	10	16	M.A.
11	0.667	W	F	SPED/ History	5	12	M.Ed.
12	0.635	AA	M	English	3	15	M.Ed.
13	0.560	AA	F	Science	17	2	Ed.S.
15	0.739	W	F	Science/ Social Studies	10	18	M.Ed.
16	0.465	AA	F	English	13	10	MA
19	0.431	AA	M	Science	13	3	M.Ed.
21	0.494	AA	F	Science	9	9	M.Ed.
22	0.706	AA	F	Math	4	14	M.Ed.

Note. W = White; AA = African American; M= Male; F = Female; ELA = English Language Arts; P.E. = Physical Education; SPED = Special Education

The z-scores were calculated for each Q-sort statement within each factor group. The z-score is a measure of the magnitude and direction of deviation from the distribution mean. The z-score or standard score that is above the mean has positive values and those below the mean have negative values. The z-scores for each statement and its ranking are presented in Table 13. The statement with the highest agreement in Factor A was Statement 18, “Encourage teachers to have positive teacher-student relationships.” This statement is the highest rank order when compared to the other statements, with a z-score of 2.1387, and is placed in the +4 column in the model factor array on the q-sort.

Table 13

Factor A Normalized Factor Scores

Statement	Z-Score	Grid Placement
Encourage teachers to have positive teacher-student relationships.	2.1387	4
Encourage teachers to actively engage students in participation and discussion.	1.5147	4
Encourage teachers to use a lot of hands-on activities utilizing student collaboration.	1.2690	3
Encourage teachers to create an atmosphere of safety/trust in their classrooms.	1.2177	3
Encourage teachers to provide feedback to students with suggestions for improvement.	1.4197	3
Encourage teachers to bring real-life examples/situations in the classroom.	0.9840	2
Encourage teachers to provide students with opportunities to collaborate and engage in academic discourse.	0.7397	2
Expect teachers to use technology and hands-on activities with students.	0.8640	2
Ensure teachers provide formative and summative assessments to determine content mastery.	0.8621	2
Encourage teachers to set high expectations for all students.	0.8963	2
Use observation evidence in a follow-up conversation.	0.6081	1
Support teachers in the implementation of division initiatives.	0.5849	1
Expect teachers to move around the room to engage off-task learners, and reengage them in the lesson.	0.8175	1
Emphasize the use of effective instructional practices to teachers.	0.6443	1
Encourage teachers to reflect on their lesson plans and adapt based on student feedback from formative assessments.	0.6119	1
Use student data to help support my conversations with my teachers.	0.8611	1
Partner with curriculum specialists/supervisors.	-0.2104	0
Celebrate with my teachers over student growth and success.	0.2663	0
Encourage teachers to provide enrichment opportunities for their students.	-0.3865	0
Require teacher-led instruction to ensure content is introduced to students as indicated in the pacing guide.	0.2214	0
Encourage teachers to use and share new technology and resources.	-0.2742	0
Provide targeted professional development based on evidence obtained from data and classroom observations.	-0.3638	0
Encourage teachers to use a classroom management system.	0.6214	0
Expect teachers to follow the instructional pacing guide.	0.2405	0
Conduct weekly observations and schedule timely follow up conferences.	-0.8736	-1
Offer opportunities for my teachers to demonstrate leadership or strength.	-0.3560	-1
Expect teachers to achieve higher than the division on common assessments and benchmarks.	-0.6129	-1
Attend trainings on new technology.	-0.6226	-1
Encourage lead teachers to facilitate collaborative learning in team meetings.	-0.6204	-1

Statement	Z-Score	Grid Placement
Encourage teachers to take an active role in the implementation of the curriculum in my school.	-0.4234	-1
Attend collaborative learning team (CLT) meetings with my teachers.	-0.8057	-2
Collaborate with teachers during the lesson planning process.	-1.1526	-2
Schedule peer observations of other teachers.	-0.8636	-2
Partner with culture/climate coaches.	-0.9713	-2
Conduct evaluations on my teachers beyond the division's expectations.	-1.1752	-2
Make suggestions and ask clarifying questions on my teachers' weekly lesson plans.	-1.4007	-3
Send my teachers appreciation notes as appropriate.	-1.3514	-3
Attend professional development opportunities for content-specific areas.	-1.2577	-3
Conduct weekly constructive debriefs.	-1.8035	-4
Participate in the curriculum development team for the area that I supervise.	-1.8576	-4

The statements are presented in descending rank order. Statement 37 ("Participate in the curriculum development team for the area that I supervise") was the lowest-ranked statement, with a z-score of -1.8576 and is placed in the -4 column in the model factor array. The model sort is shown in Figure 7, indicating the administrator experiences that these 12 participants considered to be the most supportive and effective actions that they could provide to their teachers. The model sort is an overall viewpoint that represents that factor and is the foundation for data analysis and naming the factor (Watts & Stenner, 2012).

Figure 7

Factor A Model Sort

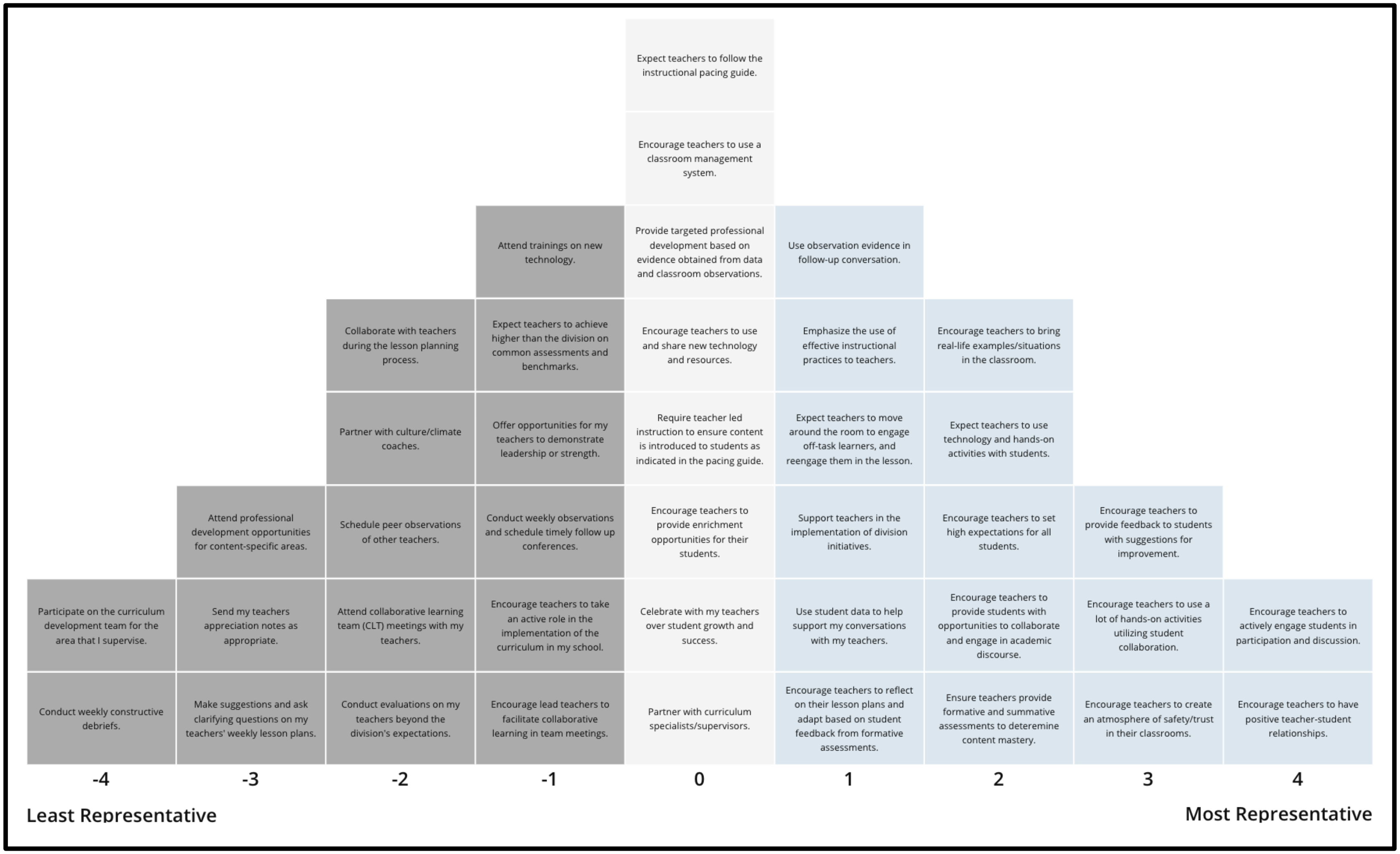


Table 14 depicts the highest and lowest ranking statements. The statements located on the boundaries of the distribution grid are the most indicative of the group perspective. These statements are the extremes and are important because they represent what participants perceived as the most and the least supportive actions an administrator takes to support their teachers.

Table 14

Factor A High-Positive and High-Negative Statements

Rank	Statement
4	Encourage teachers to have positive teacher-student relationships.
4	Encourage teachers to actively engage students in participation and discussion.
3	Encourage teachers to use a lot of hands-on activities utilizing student collaboration.
3	Encourage teachers to create an atmosphere of safety/trust in their classrooms.
3	Encourage teachers to provide feedback to students with suggestions for improvement.
-3	Make suggestions and ask clarifying questions on my teachers' weekly lesson plans.
-3	Send my teachers appreciation notes as appropriate.
-3	Attend professional development opportunities for content-specific areas.
-4	Conduct weekly constructive debriefs.
-4	Participate in the curriculum development team for the area that I supervise.

Participants loading on Factor A sorted statements 18, 22, 23, 31, and 33 on the +4 and +3 side of the distribution grid. The highest scoring statements in Factor A contained language such as: “encourage teachers to have positive teacher-student relationships,” “encourage teachers to actively engage students,” “encourage teachers to use a lot of hands-on activities,” “encourage teachers to create an atmosphere of safety/trust,” and “encourage teachers to provide feedback to students.” Common themes among these statements were teacher and student centered and actions that administrators can take to enable teachers to improve instruction and teacher-student relationships.

In the focus group interview about Factor A, Participant 19 stated, “I'm a big relationship person so I think that once you start looking at positive teacher to student relationships, that's the most important thing.” Participant 12 added, “I lean more so to really helping my teachers understand how to actively engage their students and how to build those relationships, so that they can teach students.” Similarly, Participant 21 noted, “I encourage my teachers to help move us as a school forward, and I feel like that's a larger impact or more of a high yield strategy, then just writing an actual note.” Participant 15 added, “I agree with you all. I think we are not really touchy feely, but we all like to understand our personnel and building relationships—that works.” A specific goal for this group was building relationships and encouraging teachers to build them with students.

Another area of importance discussed in Factor A was feedback and time management. Participant 19 commented,

> There's a ton of duties and responsibilities that we [as administrators] have to monitor, and they are very time consuming. While we would love to conduct weekly constructive debriefs with our teachers, there is just no time in the day to do that. If you develop those relationships with your teachers, you will know which ones are most in need of those constructive debriefs.

Participant 13 verbally agreed with this statement and echoed the same thoughts as did all others in the focus group interview.

Collectively, the participants in Factor A expressed the importance of having positive teacher-student relationships (Statement 18, +4), using hands-on activities with student collaboration (Statement 23, +3), creating an atmosphere of safety and trust (Statement 31, +3), and using real-life examples during instruction (Statement 13, +2). sing observation evidence in a follow-up conversation (Statement 10, +1) and encouraging teachers to reflect on their lesson plans and adapt based on student feedback from formative assessments (Statement 28, +1) were not as significant, implying that actions that are student centered are more important to this group of administrators.

The importance of encouraging teachers to develop and ensure meaningful relationships cannot be overstated since all of the negative statements for Factor A relate to adult-focused actions and not student-focused actions. Factor A participants did not give high rank to sending teachers appreciation notes (Statement 9, -3); Participant 13 stated, "It is important that my teachers feel appreciated, but they do not always need a note. I make sure that I tell them and show them that daily, especially now." Participants in Factor A also did not give high rank to participating in the curriculum development team (Statement 37, -4), attending professional development opportunities for content-specific areas (Statement 39, -3), or conducting weekly constructive debriefs (Statement 8, -4).

Factor B: R.E.C. League (Relationships, Encouragement, and Curriculum)

Six participants loaded significantly on Factor B. This accounts for 27% of the participants and 6% of the variance. Table 15 displays the sub-group characteristics of the participants who loaded significantly on Factor B. Five participants had taught 5 or more years before becoming an administrator. One participant was a counselor before becoming an administrator. Five of the participants in this factor had been an administrator more than 10 years and the remaining one was an administrator for fewer than 5 years. There were five African-American administrators and one White administrator in Factor B. Five participants in Factor B were female and one was male. The highest loading participant (P14) taught for 5 years and was an administrator for 13 years; the next three participants taught for 10 years or more and were administrators for more than 10 years each.

Table 15

Participants Loading Significantly on Factor B

Participant	Loading	Race	Gender	Subject	Years Taught	Years as Administrator	Highest Degree
6	0.554	W	F	Social Studies	15	16	Ed.S.
7	0.506	AA	F	Math	18	14	Ph.D.
8	0.370	AA	M	All	5	21	M.Ed.
9*	0.446	AA	F	Science/ Social Studies	14	15	Ed.D.
14	0.693	AA	F	Math	5	13	Ed.D.
17	0.432	AA	F	Counselor	6	3	Ed.S.

Note. W = White; AA = African American; F = Female; M = Male
*Participant 9 was flagged and added to this factor because it was the higher loading.

The z-scores were calculated for each Q-sort statement within each factor group. The z-score is a measure of the magnitude and direction of deviation from the distribution mean. The z-scores or standard scores above the mean has positive values and those below the mean have negative values. The z-scores for each statement and its ranking are presented in Table 16. The statement with the highest agreement in Factor B was Statement 18, “Encourage teachers to have positive teacher-student relationships.” This statement is the highest rank order when compared to the other statements with a z-score of 1.606 and is placed in the +4 column in the model factor array on the q-sort. This was also the highest-ranking statement for Factor A.

Table 16

Factor B Normalized Factor Scores

Statement	Z-Score	Grid Placement
Encourage teachers to have positive teacher-student relationships.	1.6060	4
Encourage teachers to set high expectations for all students.	1.9577	4
Attend collaborative learning team (CLT) meetings with my teachers.	1.5645	3
Ensure teachers provide formative and summative assessments to determine content mastery.	1.5639	3
Encourage teachers to take an active role in the implementation of the curriculum in my school.	1.3601	3
Collaborate with teachers during the lesson planning process.	0.8506	2
Provide targeted professional development based on evidence obtained from data and classroom observations.	0.9843	2
Encourage teachers to use a classroom management system.	0.8890	2
Encourage teachers to create an atmosphere of safety/trust in their classrooms.	1.1379	2
Expect teachers to follow the instructional pacing guide.	1.2205	2
Partner with curriculum specialists/supervisors.	0.4928	1
Support teachers in the implementation of division initiatives.	0.4125	1
Encourage teachers to actively engage students in participation and discussion.	0.4117	1
Emphasize the use of effective instructional practices to teachers.	0.6982	1
Encourage lead teachers to facilitate collaborative learning in team meetings.	0.4232	1
Use student data to help support my conversations with my teachers.	0.6442	1
Use observation evidence in follow-up conversation.	0.1871	0
Expect teachers to move around the room to engage off-task learners, and reengage them in the lesson.	0.1415	0
Celebrate with my teachers over student growth and success.	0.1008	0
Encourage teachers to provide enrichment opportunities for their students.	-0.3668	0
Expect teachers to use technology and hands-on activities with students.	-0.3072	0
Encourage teachers to reflect on their lesson plans and adapt based on student feedback from formative assessments.	0.1720	0
Encourage teachers to provide feedback to students with suggestions for improvement.	0.1205	0
Attend professional development opportunities for content-specific areas.	-0.3595	0
Make suggestions and ask clarifying questions on my teachers' weekly lesson plans.	-0.4439	-1
Conduct weekly observations and schedule timely follow up conferences.	-0.4573	-1
Encourage teachers to bring real-life examples/situations in the classroom.	-0.4117	-1
Encourage teachers to provide students with opportunities to collaborate and engage in academic discourse.	-0.7250	-1
Require teacher led instruction to ensure content is introduced to students as indicated in the pacing guide.	-0.7428	-1
Encourage teachers to use a lot of hands-on activities utilizing student collaboration.	-0.7048	-1

Statement	Z-Score	Grid Placement
Schedule peer observations of other teachers.	-0.9372	-2
Send my teachers appreciation notes as appropriate.	-1.0297	-2
Offer opportunities for my teachers to demonstrate leadership or strength.	-0.9231	-2
Expect teachers to achieve higher than the division on common assessments and benchmarks.	-1.0840	-2
Encourage teachers to use and share new technology and resources.	-1.0238	-2
Conduct weekly constructive debriefs.	-1.2938	-3
Participate on the curriculum development team for the area that I supervise.	-1.2533	-3
Conduct evaluations on my teachers beyond the division's expectations.	-1.3483	-3
Partner with culture/climate coaches.	-1.7496	-4
Attend trainings on new technology.	-1.7772	-4

The statements are presented in descending rank order. Statement 25, "Attend trainings on new technology" was the lowest-ranked statement with a z-score of -1.7772 and is placed in the -4 column in the model factor array. The model sort is shown in Figure 8, indicating the administrator experiences that these six participants considered to be the most supportive and effective actions that they could provide to their teachers. The model sort is the overall viewpoint that represents a factor, and it is the foundation for data analysis and naming the factor (Watts & Stenner, 2012). Table 17 depicts the highest and lowest ranking statements. The statements located on the boundaries of the distribution grid are the most indicative of the group perspective. These statements are the extremes and are important because they represent the perceptions of the group the most and the least essential actions that as an administrator, they take to support their teachers.

Figure 8

Factor B Model Sort

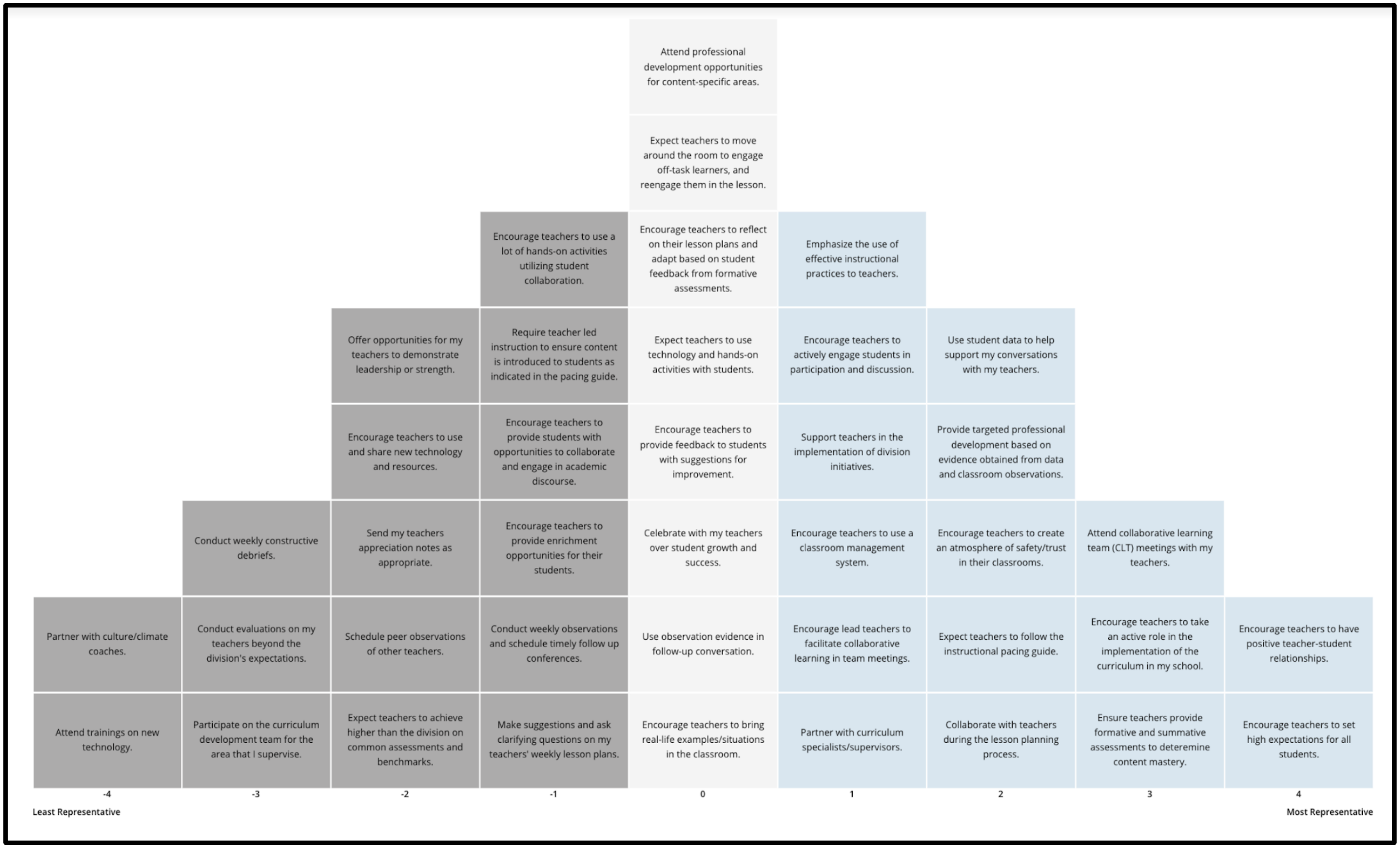


Table 17

Factor B High-Positive and High-Negative Statements

Rank	Statement
4	Encourage teachers to have positive teacher-student relationships.
4	Encourage teachers to set high expectations for all students.
3	Attend collaborative learning team (CLT) meetings with my teachers.
3	Ensure teachers provide formative and summative assessments to determine content mastery.
3	Encourage teachers to take an active role in the implementation of the curriculum in my school.
-3	Conduct weekly constructive debriefs.
-3	Participate on the curriculum development team for the area that I supervise.
-3	Conduct evaluations on my teachers beyond the division's expectations.
-4	Partner with culture/climate coaches.
-4	Attend trainings on new technology.

Participants loading on Factor B sorted statements 18, 32, 2, 29, and 35 on the +4 and +3 side of the distribution grid. The highest scoring statements in Factor B, contained language such as: “encourage teachers to have positive teacher-student relationships,” “encourage teachers to set high expectations for students,” “attend collaborative learning team meetings with teachers,” “ensure teachers provide formative and summative assessments,” and “encourage teachers to take an active role in the implementation of the curriculum.” Common themes among these statements were relationships, encouragement, and curriculum.

In the focus group interview with Factor B, Participant 7 stated, “I was looking at teachers needing to have high expectations and relationships with their students. If you have those pieces and a safe environment, you can teach anything”. Participant 9 added,

> I also looked at the classroom environment, and the classroom management. If you have control of your classroom then there is no limit, but if [you] don't have control then everything you set out to accomplish isn't going to happen. The teacher will spend time dealing with stuff that is irrelevant.

Participant 6 noted,

> As an administrator that is married to a teacher, I see the struggles that go on or the preparation for lessons and that shapes my perspective. I am a strong teacher supporter because I know the inside of the job not just what I see as an administrator going into a classroom or going into a Zoom to see what teachers are doing.

A specific goal for this group was not just on relationships, but on what could be accomplished with those relationships. This group focused on the outcomes (effective lessons, collaboration with colleagues, and high student expectations) more than the process of developing and building those relationships.

Collectively, the participants in Factor B expressed the importance of having positive teacher-student relationships (Statement 18, +4), teachers setting high expectations for all students (Statement 32, +4), attending collaborative learning team meetings with teachers (Statement 2, +3), and having teachers use a classroom management system (Statement 30, +2). Partnering with curriculum specialists/supervisors (Statement 7, +1) and supporting teachers in the implementation of division initiatives (Statement 12, +1) were not as significant, implying that actions that are teacher-centered were more important to this group of administrators.

The importance of encouraging teachers to set high expectations for all students, have positive relationships with students, and for administrators to collaborate with teachers were clear priorities for Factor B administrators. The statements for Factor B that ranked highly negative related to adult-focused actions that do not always have a direct impact on the instruction. Factor B participants did not give high rank to conducting weekly constructive debriefs (Statement 8, -3), participating in the curriculum development team (Statement 37, -3), attending trainings on new technology (Statement 25, -4), or partnering with the culture/climate coaches (Statement 6, -4).

Factor C: Eye in the Sky

Four participants loaded significantly on Factor C. This accounts for 18% of the participants and 4% of the variance. Table 18 displays the sub-group characteristics of the participants who loaded significantly on Factor C. Participant 3 significantly loaded on Factor C with a negative. This means this participant shared an inverse viewpoint. The correlation coefficient refers to the strength of a relationship between two variables and runs along the same continuum of correlation, with +1 indicating perfect positive relationship and -1 indicating perfect negative relationship (Damio, 2018).

Table 18

Participants Loading Significantly on Factor C

Participant	Loading	Race	Gender	Subject	Years Taught	Years as Administrator	Highest Degree
2	0.3745	W	M	P.E.	6	1.5	M.Ed.
3*	-0.3352	W	M	English	11	11	M.Ed.
18	0.4458	AA	F	English	14	16	Ed.D.
20	0.5764	AA	F	Science	4	13	M.Ed.

Note. W = White; AA = African American; M = Male; F = Female, P.E. = Physical Education
*Participant 3 negatively loaded onto this factor.

Three participants in Factor C had taught 5 or more years before becoming an administrator. One participant taught for 4 years before becoming a behavior specialist and then an administrator. Three of the participants in this factor were administrators more than 10 years and the remaining one was an administrator for fewer than 5 years. There were two African American administrators and two White administrators in Factor C. Two participants in Factor C were female and two were male. The highest loading participant (P20) reported teaching for 4 years and being an administrator for 13 years; the next three participants reported teaching for 5 years or more. Two participants reported being an administrator for more than 10 years each. Participant 2 reported being an administrator for 1.5 years.

The z-scores were calculated for each Q-sort statement within each factor group. The z-score is a measure of the magnitude and direction of deviation from the distribution mean. The z-scores or standard scores above the mean have positive values and those below the mean have negative values. The z-score for each statement and its ranking are presented in Table 19. The statement with the highest agreement in Factor C was Statement 32, “Encourage teachers to set high expectations for all students.” This statement is the highest rank order when compared to the other statements, with a z-score of 1.499 and is placed in the +4 column in the model factor array on the q-sort. This was also the second highest ranking statement for Factor B.

Table 19

Factor C Normalized Factor Scores

Statement	Z-Score	Grid Placement
Encourage teachers to set high expectations for all students.	1.499	4
Use student data to help support my conversations with my teachers.	1.331	4
Conduct weekly observations and schedule timely follow up conferences.	1.329	3
Use observation evidence in follow-up conversation.	1.224	3
Encourage teachers to reflect on their lesson plans and adapt based on student feedback from formative assessments.	1.213	3
Attend collaborative learning team (CLT) meetings with my teachers.	1.036	2
Celebrate with my teachers over student growth and success.	1.112	2
Expect teachers to use technology and hands-on activities with students.	1.045	2
Emphasize the use of effective instructional practices to teachers.	1.001	2
Conduct evaluations on my teachers beyond the division's expectations.	1.192	2
Conduct weekly constructive debriefs.	0.576	1
Encourage teachers to bring real-life examples/situations in the classroom.	0.581	1
Encourage teachers to have positive teacher-student relationships.	0.473	1
Encourage teachers to actively engage students in participation and discussion.	0.736	1
Ensure teachers provide formative and summative assessments to determine content mastery.	0.659	1
Expect teachers to follow the instructional pacing guide.	0.600	1
Schedule peer observations of other teachers.	-0.036	0
Partner with curriculum specialists/supervisors.	0.186	0
Encourage teachers to provide students with opportunities to collaborate and engage in academic discourse.	-0.041	0
Encourage teachers to provide enrichment opportunities for their students.	0.122	0
Encourage teachers to use and share new technology and resources.	0.106	0
Encourage teachers to use a classroom management system.	-0.032	0
Encourage teachers to create an atmosphere of safety/trust in their classrooms.	-0.140	0
Encourage teachers to provide feedback to students with suggestions for improvement.	0.315	0
Collaborate with teachers during the lesson planning process.	-0.212	-1
Send my teachers appreciation notes as appropriate.	-0.596	-1
Expect teachers to move around the room to engage off-task learners, and reengage them in the lesson.	-0.191	-1
Encourage teachers to use a lot of hands-on activities utilizing student collaboration.	-0.662	-1
Provide targeted professional development based on evidence obtained from data and classroom observations.	-0.200	-1
Attend professional development opportunities for content-specific areas.	-0.340	-1
Partner with culture/climate coaches.	-1.135	-2

Statement	Z-Score	Grid Placement
Offer opportunities for my teachers to demonstrate leadership or strength.	-1.142	-2
Expect teachers to achieve higher than the division on common assessments and benchmarks.	-0.697	-2
Encourage teachers to take an active role in the implementation of the curriculum in my school.	-1.211	-2
Participate on the curriculum development team for the area that I supervise.	-0.978	-2
Support teachers in the implementation of division initiatives.	-1.700	-3
Attend trainings on new technology.	-1.594	-3
Encourage lead teachers to facilitate collaborative learning in team meetings.	-1.540	-3
Make suggestions and ask clarifying questions on my teachers' weekly lesson plans.	-1.712	-4
Require teacher led instruction to ensure content is introduced to students as indicated in the pacing guide.	-2.178	-4

The statements are presented in descending rank order. Statement 19, “Require teacher led instruction to ensure content is introduced to students as indicated in the pacing guide” was the lowest-ranked statement, with a z-score of -2.178, and is placed in the -4 column in the model factor array. The model sort is shown in Figure 9, indicating the administrator experiences that these four participants considered to be the most supportive and effective actions that they could provide to their teachers. The model sort is the overall viewpoint that represents that factor and is the foundation for data analysis and naming the factor (Watts & Stenner, 2012).

Figure 9

Factor C Model Sort

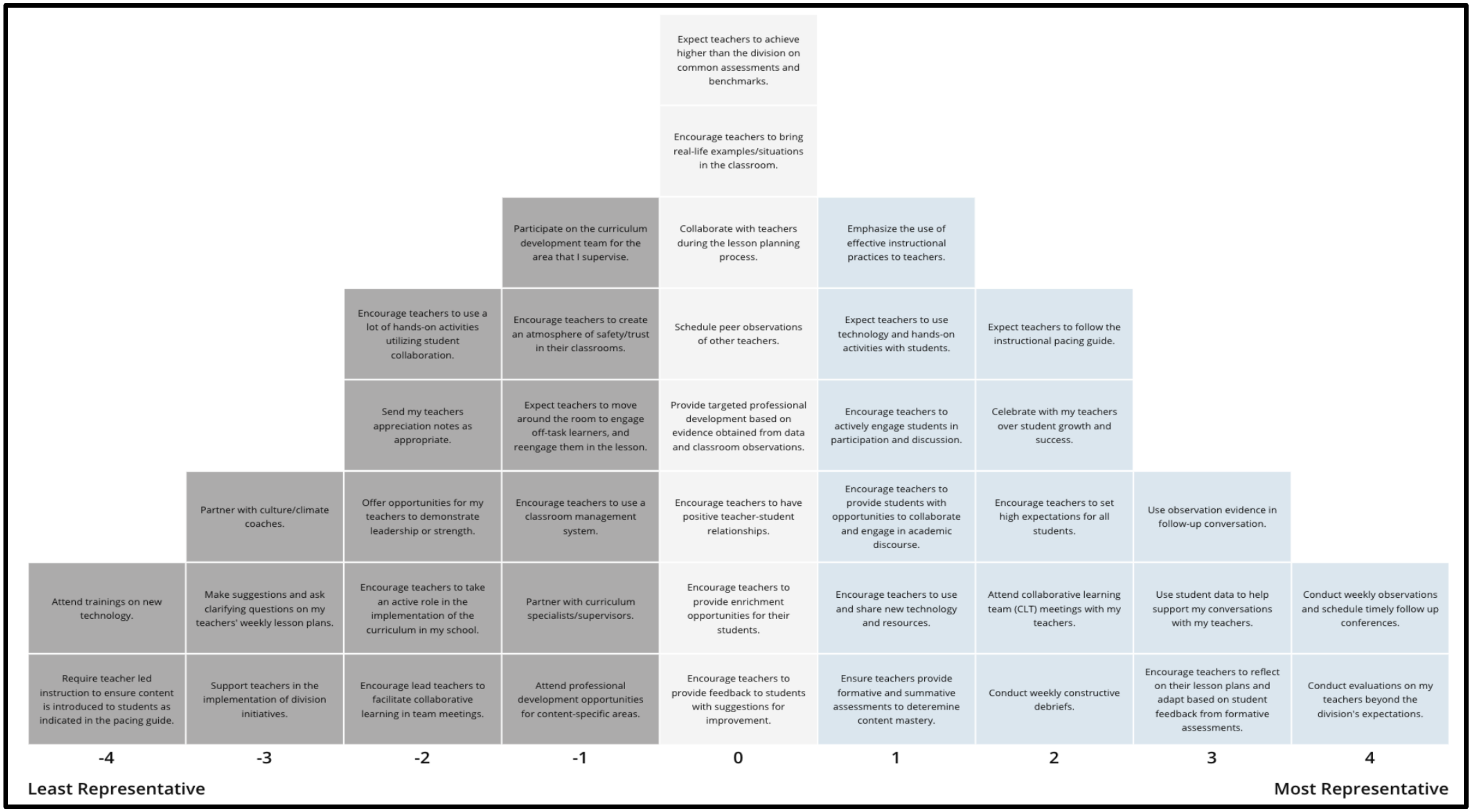


Table 20 depicts the highest and lowest ranking statements. The statements located on the boundaries of the distribution grid are the most indicative of the group perspective. These statements are the extremes and are important because they represent the perceptions of the group the most and the least essential actions that as an administrator, they take to support their teachers.

Table 20

Factor C High-Positive and High-Negative Statements

Rank	Statement
4	Conduct weekly observations and schedule timely follow up conferences.
4	Conduct evaluations on my teachers beyond the division's expectations.
3	Use observation evidence in follow-up conversation.
3	Encourage teachers to reflect on their lesson plans and adapt based on student feedback from formative assessments.
3	Use student data to help support my conversations with my teachers.
-3	Make suggestions and ask clarifying questions on my teachers' weekly lesson plans.
-3	Partner with culture/climate coaches.
-3	Support teachers in the implementation of division initiatives.
-4	Require teacher led instruction to ensure content is introduced to students as indicated in the pacing guide.
-4	Attend trainings on new technology.

Participants loading on Factor C sorted statements 32, 40, 4, and 10 on the +4 and +3 side of the distribution grid. The highest scoring statements in Factor C contained language such as: “encourage teachers to set high expectations for students,” “use student data to help support my conversations with teachers,” “conduct weekly observations and schedule follow-up conferences,” and “use observation evidence in follow-up conversation.” Common themes among these statements were data informed decision making and evidence for teacher conversation.

In the focus group interview about Factor C, Participant 3 stated, “When you're looking at teachers, and how you can help them, it's always good to have those discussions”. Participant 3 added, “help teachers write lessons on a weekly basis is not something I really do but meeting with teachers on a weekly basis that to me is super important”. Participant 2 noted,

> When I think about working with and growing teachers, I do not feel attending a training on new technology is as important as conducting weekly observations and scheduling those follow-up conferences, because I think that that should be number one. Because when you get a teacher one-on-one, and you can give them meaningful feedback—That's where growth happens because there's no other distractions there it's just doing them and you're just talking, and then you take ego out of it, there's no audience, it's just you and them.

A specific goal for this group was teachers having high expectations for all students and using different measurements to support teacher feedback conversations. This group focused on evidence (student data, observation evidence and weekly observations with follow-up conferences) more than building teacher-student relationships.

Participants in Factor C expressed the importance of setting high expectations for all students (Statement 32, +4), using student data to support conversations with teachers (Statement 40, +4), using observational evidence with teachers (Statement 10, +3), and attending collaborative learning team meetings with teachers (Statement 2, +2). They also expressed that encouraging teachers to have positive teacher-student relationships (Statement 18, +1) and encouraging teachers to actively engage students in participation and discussions (Statement 22,

+1) were not as significant, implying that collecting evidence and making data informed decisions was more important to this group of administrators.

The importance of encouraging teachers to set high expectations for all students as well as using student data and observational evidence with teachers were clear priorities for Factor C administrators. The statements for Factor C that ranked highly negative related to adult-focused actions that are aimed at improving instructional delivery, but are not student mastery. Factor C participants did not give high rankings to attending trainings on new technology (Statement 25, -3), supporting teachers in the implementation of division initiatives (Statement 12, -3), making suggestions or asking clarifying questions on teachers' lesson plans (Statement 1, -4), or requiring teacher-led instruction to ensure content is introduced according to the pacing guide (Statement 19, -4).

Consensus Statements

The statements that were placed in a statistically similar location on the distribution grid of each model array for all three factors are referred to as consensus statements. The three-factor solution used in this study generated three consensus statements: one on the positive side, one on the negative side, and one in the middle of the continuum. The consensus statements are shown on Table 21. Statement 27, "emphasize the use of effective instructional practices to teachers" was valued on the positive side of the continuum. This is consistent with the participants in all factors; however, participants in Factor C held it at a higher value than those in Factors A and B. It is surprising that Statement 27 was not ranked higher on the positive side of the continuum. This statement was supported by the literature that linked school administrators' feedback to instruction, and its influence on a teacher's instructional practices (McNeill et al., 2018; Ovando, 2005).

Table 21

Consensus Statements

Statement	Grid Placement		
	A	B	C
Emphasize the use of effective instructional practices to teachers.	+1	+1	+2
Encourage teachers to provide enrichment opportunities for their students.	0	0	0
Expect teachers to achieve higher than the division on common assessments and benchmarks.	-1	-2	-2

Participants in all factors universally valued Statement 17, "encourage teachers to provide enrichment opportunities for their students." This statement was placed as a neutral statement. It was neither positively nor negatively valued by the three factor groups. This statement was supported by the literature review particularly in providing these opportunities for all students (Kruse & Buckmiller, 2015; Shaked & Benoliel, 2020). It is possible that participants in this study were not aware of the value of having teachers provide enrichment opportunities for all students. It is also possible that the school district provides those opportunities, and administrators do not perceive enrichment is a responsibility of the teachers. The term enrichment might have been interpreted differently for administrators in this study. Based on the forced choice of the q-sort some statements would be selected at 0 and administrators in this sample did not have a strong connection to that statement.

Participants in all factors rejected Statement 21, "expect teachers to achieve higher than the division on common assessments and benchmarks." It was more strongly rejected by participants in Factors B and C. It is unclear as to whether participants did not agree with Statement 21 because they saw this as only one form of evidence of mastery or if they rejected it for other reasons, but it did not significantly rank as their perception of an effective action to help teachers improve instruction. The participants felt that there were other factors that could cause a fluctuation in scores and did not lean on this one as an indicator of good instruction.

Feedback from the Participants after the Q-sort

After the Q-sort process was complete, I sent the questionnaire to each participant and they responded with the demographic information and thoughts on the Q-sort process. The Q-sort process was also discussed during the post-sort interviews. All participants commented that the process forced them to reflect on what they truly value when they think about their supportive actions for teachers. A few commented that they liked the process despite finding it a bit challenging. Participants stated that they used the introductory video that I created to guide them through the process. Participant 3 stated that the driving thought during the q-sort process was being a strong advocate for teachers and looking at the actions that aligned with that thought. Participants 15, 9, 13, and 5 all reported that they went back and made changes after looking at the +4 statements and -4 statements. Participant 7 stated that it took a while to get started because they had too many +4 statements in the pre-sorted pile.

Participants agreed that the statements were clear, and the phrasing was concise. There were no statements that the participants wanted to change or add to the Q-sort. Participants enjoyed the Q-Sort and reported that it was not time-consuming to complete. This was the first time any of the participants had ever participated in the Q-sort process.

Post-Sort Interviews: Research Questions 2 & 3 Data Collection

Fourteen secondary school administrators were interviewed about science instruction and science supervision. These administrators also participated in the Q-sort and were represented in the three-factor solution as well. A review of the research questions and how each was answered is presented in Table 4 at the beginning of Chapter 4. Research Questions 2 (What do administrators notice when watching science instruction?) and 3 (How comfortable are administrators at supporting and delivering effective feedback to science teachers?) were answered through the data collection of the post-sort questionnaire and the focus group interviews. Given conditions surrounding the COVID-19 pandemic, the study purposely focused on one school district to ensure access to administrators. The focus group interviews were conducted via Zoom and the science lesson was taught via Zoom due to schools in this district relying on virtual instruction at the time of the study.

The post-sort interviews were conducted with those participants that gave of their time to watch the science clip, complete the consent and questionnaire, and participate in the interviews via Zoom. Fourteen administrators elected to participate in the post-sort questionnaires and focus group interviews. Table 22 displays the sub-group characteristics of the focus group participants. Six participants reported having taught science before becoming an administrator. Of the six participants who were former science teachers, five were former middle school science teachers and one was a former high school science teacher. The average number of years teaching was approximately 11 years. All 14 participants were responsible for observing and supervising science instruction in their schools.

Table 22

Administrators Information

Participant	Race	Gender	Subject	Years Taught	Years as Administrator	Highest Degree
1	W	M	History	14	3	Ed.S
2	W	M	P.E.	6	1.5	M.Ed.
3	W	M	English	11	11	M.Ed.
4	AA	F	ELA	7	8	M.A.
5	W	F	Science	16	1	Ed.S
6	W	F	Social Studies	15	16	Ed.S.
7	AA	F	Math	18	14	Ph.D.
9	AA	F	Science/ Social Studies	14	15	Ed.D.
12	AA	M	English	3	15	M.Ed.
13	AA	F	Science	17	2	Ed.S.
15	W	F	Science/ Social Studies	10	18	M.Ed.
17	AA	F	Counselor	6	3	Ed.S.
19	AA	M	Science	13	3	M.Ed.
21	AA	F	Science	9	9	M.Ed.

Note. Participant numbers are the same as those who participated in q-sort. W = White; AA = African American; M = Male; F = Female; ELA = English Language Arts

All focus group participants watched a science clip from eighth-grade science instruction, which lasted approximately 8 minutes. This video was of a Zoom class due to the school district being 100% virtual at that point in the school year. The 8 minutes was selected to fit within the time constraints of the study. The teacher gave a brief overview of heat transfer and provided examples then reviewed the popcorn lab done in the previous lesson. Students were expected to share their understanding of the heat transfer, discuss, and provide authentic examples. The video illustrated different norms in terms of classroom instruction given the virtual setting and student engagement in the science practices outlined in Chapter 2. Administrators were asked to watch the video and provide written feedback to two questions: “After watching the science lesson, what did you notice during the lesson?” and “Based on your perceptions of the most effective feedback and support, what feedback and support would you provide to this teacher regarding science instruction?” All interviews were recorded and transcribed for analysis.

Data Analysis and Coding of Post-Sort Interviews and Questionnaires

The coding for the science practices was developed from review of the literature presented in Chapter 2 and an initial analysis of the data. Members of the research team agreed on the initial codes used. The statement placements were initially done by rater 1, and rater 2 and 3 confirmed the findings of rater 1. Rater 2 measured 86.6% success that meant rater 2 agreed for 65 points (statement placements) out of the 75 points (statement placements). Rater 3 measured 80% success and that meant that rater 3 agreed for 60 points out of the 75 points. The team met to discuss the placements and reached an agreement on all codes that were used. The selected codes also aligned with the research and goals related to NGSS science practices and the state science standards (Berland et al., 2016; Osborne, 2014). Recall from Chapter 2, the three spheres are investigating, sensemaking and evaluating/critiquing (McNeill et al., 2015). Given the traditional emphasis in inquiry science, my expectation was that investigating would appear in the discussion more than sensemaking or evaluating practices. The top-down approach (deductive with pre-set coding schemes) was used to address Research Question 2 and provide clear themes to categorize what administrators noticed about the science lesson they viewed (Table 23). Administrators with a background in science or those administrators that had more than 10 years’ experience notice more of the investigating science practices.

Table 23

Codes for Science Practices

Code	Description	Examples from Interviews
Investigating Practices	Administrator's feedback discusses at least one of the following: Asking questions regarding data, claims, evidence, and the design of the investigation. Planning an investigation Collecting data Conducting an experiment	Participant 15 stated that the teacher and students discussed the popcorn lab that they conducted during the previous class, and the teacher asked the students to reference their data to respond.
Sensemaking Practices	Administrator's feedback discusses at least one of the following: Analyzing or interpreting data Constructing an explanation Developing or using a model	Participant 19 highlighted that the teacher gave the students the real-world examples of heat transfer. Participant 7 stated that the teacher gave the class the example of a slide in the summer and asked them to explain the type of heat transfer and why.
Critiquing Practices	Administrator's feedback discusses at least one of the following: Engaging in argument from evidence Obtaining, evaluating or communicating information	Participant 5 mentioned the teacher asking for examples of heat transfer in the chat and then having the class agree or disagree with the examples and their explanations.

As the coding proceeded, additional themes and activities emerged that were not covered by the top-down approach; therefore, a bottom-up approach (inductive with the patterns from the data) was used to address Research Question 3. In addition to the codes for science practices, other codes emerged from the focus group interviews and post-sort questionnaires these were also as a result of the inductive portion of the analysis. Table 24 shows the codes for science instruction that emerged from an analysis of the post-sort interviews and questionnaires administrators completed immediately after watching the science clip.

Table 24

Codes for Science Instructional Practices

Code	Practices	Description
Language (science)	S	Discussed how the language is used by teacher and students in the instruction and the explanation "science talk"
Presentation	S, C	Mentioned teacher delivery of the lesson, and how they disseminate the content
Pedagogy	I	Covered strategies about the lesson, such as essential question, visuals, structure of activity, scaffolding of lesson, and arrangement or student groups
Student Engagement	I, S, C	Feedback on students that were on-task, off-task, participating in the lesson, and student cameras on
Evidence	I, S, C	Discussed students collecting or using evidence or data
Natural World	I, S	Gave authentic examples of science used in the lesson
Hands-On	I	Mentioned students conducting labs, using science at-home kits

Note. I = Investigating; S = Sensemaking; C = Critiquing

In response to Research Question 3, administrators were asked to provide feedback to the teacher in the science clip. They were also asked how comfortable they would be delivering that feedback. All administrators stated that they would be very comfortable delivering their feedback to the teacher. Table 25 shows the codes for the overall feedback for the teacher. The goal of these codes was to capture whether the feedback was specifically related to science practices exhibited in the clip of the lesson.

Table 25

Evaluation Codes for Administrators' Feedback

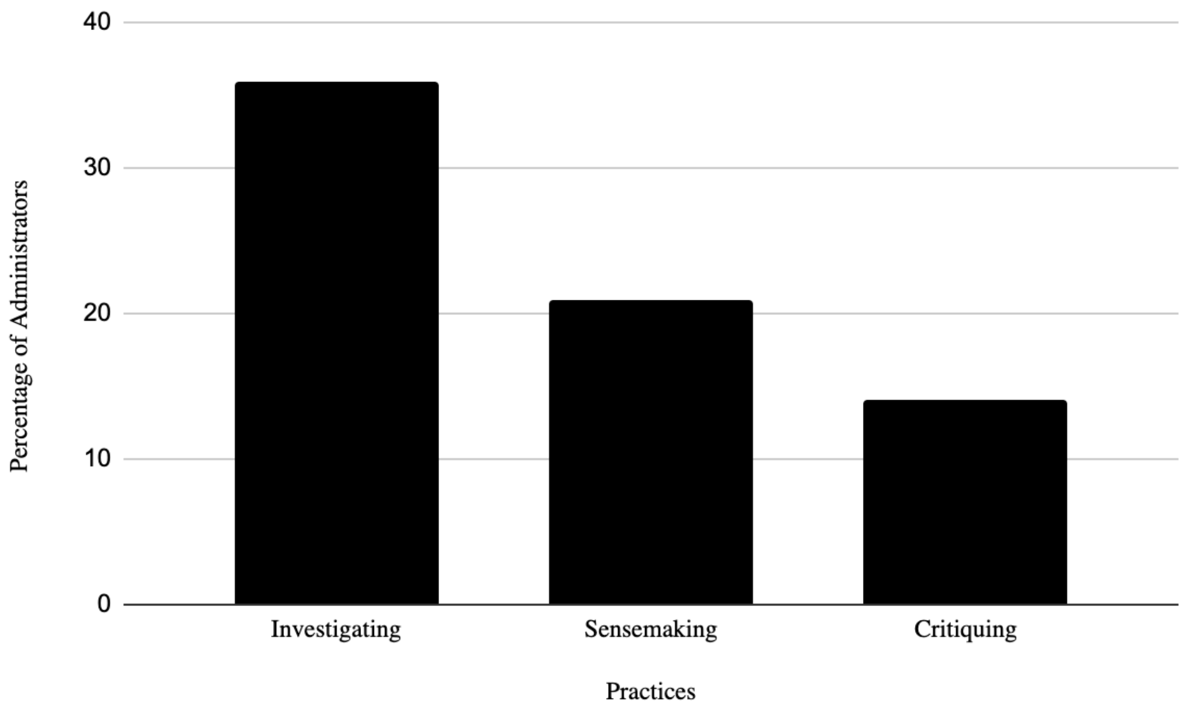
Code	Description
Positive	The administrator's feedback is overall positive and evaluative in nature, with one or fewer areas for improvement given.
Neutral	The administrator's feedback is overall neutral and more descriptive, with a balance of positive and negative comments given.
Negative	The administrator's feedback is overall negative and evaluative in nature, with two or more areas for improvement given.

Investigating Practices

Investigating practices include asking questions, planning and carrying out investigations, collecting data, conducting an experiment, or observing phenomena (NRC Framework, 2012). In describing what they noticed, some administrators (36%) discussed the investigating practices, mentioning a lab that the teacher references during the lesson (Figure 10). Participant 15 stated that the teacher and students discussed the popcorn lab that they conducted during the previous class and the teacher asked the students to reference their data to respond. Participant 13 also commented that the teacher and students discussed the popcorn lab, and the teacher had the students identify each type of heat transfer experienced during the investigation.

Figure 10

Practices Administrators Noticed During Science Lesson



Sensemaking Practices

Sensemaking practices include analyzing and interpreting data, developing and using models, and explaining how or why a phenomenon has occurred (NRC Framework, 2012). A few administrators (21%) mentioned sensemaking practices or addressed that students should be looking at their investigations, analyzing the data, constructing an explanation, and developing models (Figure 10). Participant 19 highlighted that the teacher gave the students real-world examples of heat transfer and the students responded. Participant 7 noted that the teacher gave the class the example of a slide in the summer and asked them to explain the type of heat transfer and why. Participant 9 also mentioned that the teacher used different examples of heat transfer for students and asked them to respond to her in the chat with their explanations.

Critiquing Practices

Critiquing practices include engaging in argumentation from evidence, evaluating information, or students questioning and evaluating each other's ideas (NRC Framework, 2012). Only two (14%) of the administrators mentioned this practice in their "notice" responses (Figure 10). Participant 5 mentioned the teacher asking for examples of heat transfer in the chat and then having the class agree or disagree with the examples and their explanations. Participant 12 stated that the students responded in the chat and the teacher instructed them to discuss their examples with the class.

Administrators demonstrated an understanding of the investigating, sensemaking, and critiquing practices; however, these practices were not all seen in equal measure during the science clip. Investigating practices and sensemaking practices were the easiest for administrators to notice. Critiquing practices were less obvious to the administrators and most did not notice the teacher asking students to place examples in the chat before prompting the class to agree or disagree with their classmates and give an explanation and evidence.

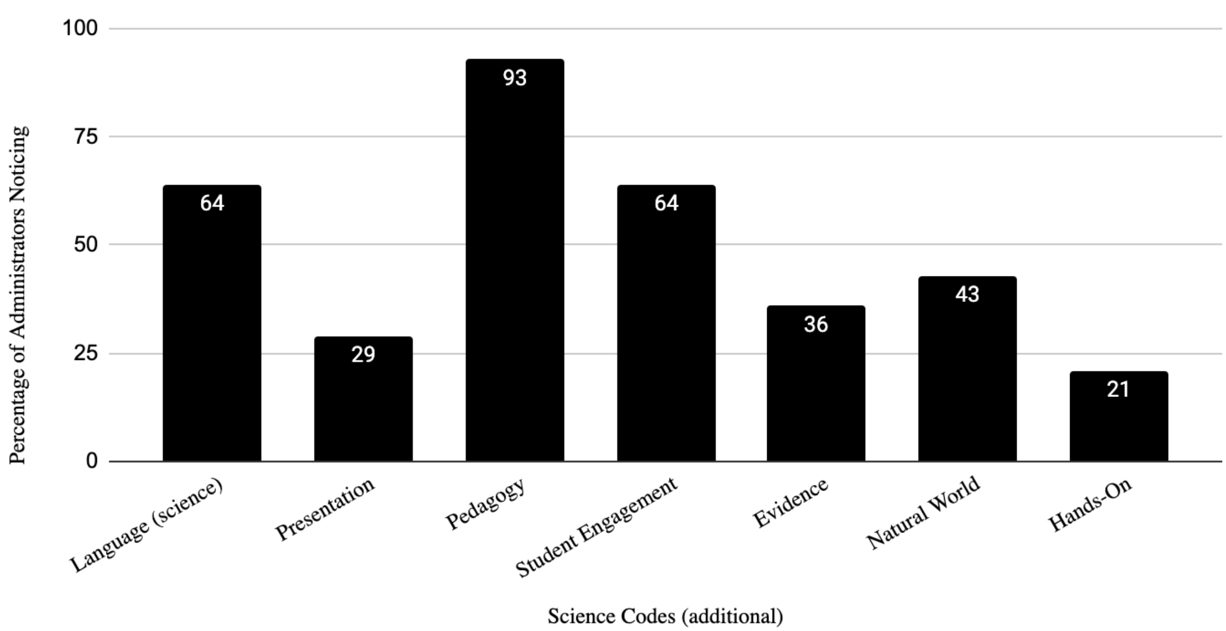
Science Codes Administrators Noticed

In addition to the three codes, I used to classify the administrators noticing statements on the science clip, other codes emerged that were closely aligned with the science practices. Table 24 shows the codes with the science practice(s) that they align with based on the statements from the administrators. These codes emerged from the post-sort questionnaire and focus group interviews. For example, Participant 15 mentions that the teacher and the students discussed the popcorn lab from the previous class and students identified all forms of heat transfer and explained giving evidence. This response was coded for *investigating practices* and *critiquing* *practices* (Table 23), as well as *evidence*, *science language*, *hands-on*, and *student engagement* (Table 24).

In addition to coding the science practices administrators noticed, I coded responses for other topics that were evident. The additional codes aligned closely with the science practices (Table 24). Across the seven additional codes, different meanings dealt with each code; however, each code has a description and all responses fell within that description. The percentage of administrators who mentioned each code in their questionnaire or interview is shown in Figure 11. *Pedagogy* was the most common code applied to administrators' responses. That meant that an administrator discussed an element of the lesson such as essential questions, visuals, structure of activity, scaffolding of lesson, and arrangement or student groups in their response.

Figure 11

Emergent Codes for What Administrators Noticed in the Science Clip



Almost all (93%) administrators discussed pedagogy in their responses on what they noticed during the science clip. Participants 1, 4, 6, 7, 9, 12, 15, and 21 discussed the structure of the lesson; the success criteria and learning intentions; the use of Peardeck (an interactive slideshow tool) for formative assessment; how each student was placed in groups within the program; and how the teacher was able to control the content that the students saw on their screens. Other participants discussed at least one of the elements of pedagogy. The science language code and the student engagement code were the next highest applied to administrators' responses.

Administrators also mentioned student engagement (64%) and science language (64%) in their responses. The science language code covered administrators' responses that discussed the observed teacher's science language. Participants 5, 7, 9, 15, and 19 specifically mentioned conduction, convection, radiation, and heat transfer in their responses. They stated that the teacher and the students gave numerous examples of each in the chat and orally during the lesson. Participants 2, 5, 7, 9, 19, and 21 noted student engagement in their feedback. They all mentioned students being engaged through their discussions, responses in the chat or in Peardeck. Participants 1, 12, and 13 discussed not hearing all students talk during the lesson. The teacher used the chat feature (which Participant 12 noted), but administrators wondered if that was enough to keep students engaged throughout the entire lesson.

The remaining codes that administrators focused on in their noticings during the science clip were the *natural world* (43%), *evidence* (36%), *presentation* (29%), and *hands-on* (21%). Participant 19 stated that the teacher encouraged students to give real world examples of heat transfer, and the teacher also gave additional real-life examples. Five administrators (36%) mentioned students using evidence or data to support their conclusion. Participants 3, 1, and 4 discussed how the teacher presented the lesson. The administrators mentioned the use of humor, addressing students by name, and different ways the teacher delivered the material to the class in a virtual setting. Hands-on was the lowest code mentioned by administrators. This was a continuation lesson where the students referenced the lab they conducted during the previous class. Only three administrators (21%) noticed this and mentioned it during the interviews.

Administrators' Feedback and Support Actions

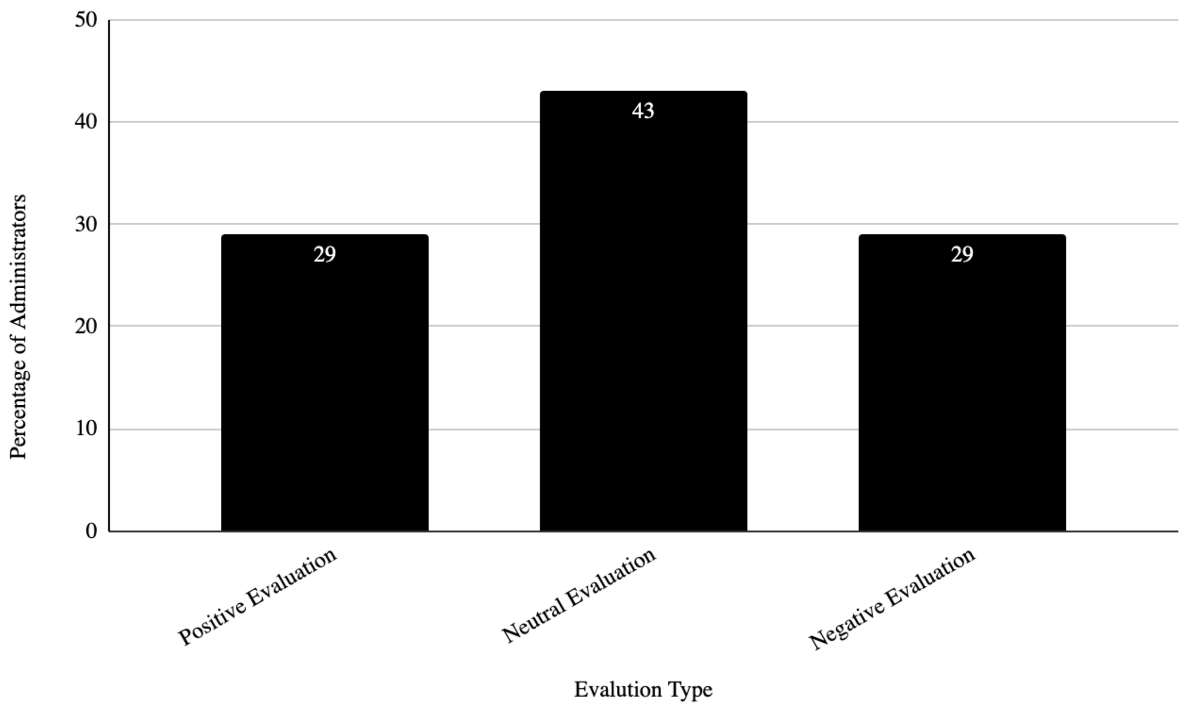
Administrators were asked to consider their perception of the most effective feedback and support actions and respond with the actions they would take with the secondary science teacher they observed. They were also asked how comfortable they would feel giving their feedback and support to that teacher. While reviewing the feedback portion of the questionnaire and the transcripts from the interviews, another characteristic emerged: the overall tone of the feedback (*positive*, *negative*, or *neutral*). A positive evaluation meant that the administrator's feedback was overall positive and evaluative in nature, with one or fewer areas for improvement given. A neutral evaluation meant that the administrator's feedback was overall more descriptive, with a balance of positive and negative comments given. A negative evaluation meant that the administrator's feedback was overall negative and evaluative in nature, with two or more areas for improvement given.

Figure 12 shows participants' overall evaluation for the science clip. Overall, administrators' evaluations were neutral (43%), with a balance of positive (28.5%) and negative (28.5%) as well. The evaluations were often based on other elements of the lesson and not on specific science feedback. Participant 2 stated that they would ask the teacher what system they had in place to ensure that they were calling on all students in the class. Participant 9 suggested that the teacher establish a classroom management system that incorporates when it is appropriate for students to speak and when open conversations are acceptable. Participant 19 praised the teacher and only suggested using a different method for formative assessment to ensure that students were giving all original responses to the types of heat transfer to ensure every student understood the concepts. Participant 7 also praised the teacher for providing students with opportunities to collaborate and engage in academic discourse.

Participants 5, 6, 7, 15, 19, and 21 (43%) included science practices in their feedback for the teacher. Participants 5, 15, 19, and 21 all were former science teachers and Participants 6 and 7 were a former social studies and math teacher respectively. However, Participants 6 and 7 had been administrators for more than 10 years. The focus on science practices provides a possible option for administrators to offer secondary science teachers feedback without needing expertise in every specific science content area. All participants stated that they would feel very comfortable providing their stated feedback or support actions for the secondary science teacher.

Figure 12

Administrators Evaluation of the Science Lesson



Summary

Chapter 4 presented an analysis of the data. The data were generated from a combination of quantitative and qualitative sources and were used to gain an understanding of administrators' perspectives concerning effective feedback and support for teachers. The data were collected from 22 secondary school administrators on their perceptions of effective support and feedback for teachers; additional data were collected to gain a deeper understanding of what administrators noticed when watching a science lesson clip, and how comfortable they would be providing feedback to science teachers.

First, Q-sorts were completed, then a factor analysis was run to compute the statistical data and determine the factors. Three distinct factors emerged: *Effective Encouragers, R.E.C. League (Relationships, Encouragement and Curriculum)* and *Eye in the Sky*. Post-sort interviews were conducted with a sample of the participants who loaded onto each factor to further explore their views of effective actions to support teachers, noticing of science instruction, and comfort with providing a science teacher observational feedback.

Chapter 5 examines the implications of the study's findings. It begins with a summary of the findings and the connections to the literature. Chapter 5 also discusses the implications of the study for policy, future research, and educational practice.

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

This chapter provides a summary of the findings and an analysis of how the results relate to the extant literature. The discussion is based on the results from the administrators' Q-sorts and from the subsequent focus group interviews with those administrators. Additionally, the findings are considered in the contexts of current and future research and practice that are relevant to improving administrators' feedback and support for secondary science teachers. Finally, the implications of the findings for secondary, division-, and state-level administrators as well as educational researchers are presented. The Q-analysis of participants' viewpoints relating to effective actions of administrators to support secondary science teachers are summarized below according to the results for each factor.

The three research questions of this study have been answered by the development of the 40 statements that reflect effective actions of administrators, use of quantitative and qualitative data to develop factor names and descriptions, and participant responses and quotes. A review of the research questions and how each was addressed is presented in Table 26.

Table 26

Research Questions and Data Type

Research Question	Data Type
1. What are secondary school administrators' perceptions of effective support and feedback to classroom teachers?	40 statements (Table 1) Factor names
2. What do secondary administrators "notice" when watching science instruction?	Participant responses (coded)
3. How comfortable are secondary administrators at supporting and delivering effective feedback in science classrooms?	Participant responses (coded)

Summary of Main Findings with Connections to the Literature

Q-Methodology was used in this study to identify and examine administrators' perceptions about the focus of an administrator's instructional roles and their capacity to foster quality support for teachers and students particularly in the area of science. Three factors, or viewpoints emerged from the study. The three factors provided a representation of what secondary administrators in the study believed to be the most effective actions to support teachers. In addition to the data analyzed from the q-sort, post-sort interview findings were considered which included administrators shared noticings of a secondary science lesson and their feedback for the teacher.

Emerging Factors from Q-Sort

Factor A: Effective Encourages

The 12 administrators (five with science backgrounds) who loaded on Factor A had strong belief in encouraging teachers. These participants were focused on building relationships. They encouraged teachers to have positive relationships with students, engage students in the lessons, use hands-on activities, develop a safe atmosphere of trust, and provide students with feedback. This group highly valued a positive relationship between teachers and students. The administrators in this group felt that if teachers had good relationships with students, then they could address all other challenges in the classroom. Those who loaded in Factor A felt their calling was to be effective and encouraging administrators.

Consequently, this group did not place participating in curriculum development teams or attending professional development opportunities for content-areas they supervised in a high priority on the q-sort. The group also felt that teachers should attend content trainings, and that as administrators they should support and encourage their teachers to implement new practices. It was important to note that several administrators in this factor agreed that they often become inundated with managerial tasks that keep them out of the classroom and unable to conduct those tasks that an instructional leader would perform on a regular basis. As stated in Chapter 2, tasks such as daily focus on instruction, effective communication with teachers and students, provide timely feedback to teachers, demonstrate knowledge of instruction and focused professional development are all essential to instructional leadership (Carraway & Young, 2015).

School administrators are in a position to influence the teaching and learning in their schools, but without sufficient knowledge of the content it would be difficult to understand the new science practices, support the curricula changes, and give constructive observational feedback to teachers to improve instruction. Administrators need to receive the knowledge of the science practices to aid them in identifying the practices in the classroom and giving teachers feedback that will promote teacher self-efficacy. Teachers expect their administrators to have instructional knowledge and pedagogical content knowledge (Zepeda, 2012; Cochran, 1997). Administrators are not expected to know the content for every science class, but they should know the science practices (investigating, sensemaking and critiquing) that cross all science disciplines.

Factor B: R.E.C. League (Relationships, Encouragement and Curriculum)

The six administrators (one with a science background) in Factor B were focused on high expectations and student performance. They encouraged teachers to have positive relationships with and set high expectations for students, attend collaborative learning team meetings, ensure teachers are assessing students, and take an active role in the implementation of the curriculum. This group felt that having a positive relationship was important as a means to get students to perform well on tests and learn the content that is needed. This group felt that a classroom that is well managed, with curriculum being taught and tested, and a positive relationship between the teacher and the students, will be a productive one. Administrators in Factor B felt they would be the most effective at supporting a teacher with that structure in their classroom.

This group was very strategic and had a balanced approach to their leadership. Factor B group valued positive teacher-student relationships, high expectations for all students, being in collaborative learning team meetings and having their teachers actively implementing the curriculum. Factor B did not place a high value on participating in curriculum development team nor attending technology trainings or working with the culture/climate coaches. This group shared that they made instruction a priority and that is being in those team meetings with their teachers and ensuring that their teachers are implementing the curriculum is a priority. The participants in this group understand that administrators influence the teaching and learning in their buildings. This group would benefit from a focus being placed on the new science practices as it would allow them to continue to support their teachers in implementing the curricula changes that are needed. The goal of Factor B administrators was improved learning outcomes and based on the literature review in Chapter 2 that is obtained through effective instructional leadership practices (Heck & Hallinger, 2010; Tsakeni, 2020).

Factor C: Eye in the Sky

The four administrators who loaded into Factor C (one with a science background) expected teachers to have high expectations for students through data driven decision-making. Participants encouraged teachers to set high expectations for students and use student data and observational evidence in conversations with teachers to improve instruction. They also conduct weekly observations with teacher follow-up conversations. This group felt it was important to have evidence when sitting down to work with a teacher. Factor C felt the priority should be placed on weekly observations, teacher evaluations and having student data driven conversations. They placed less value on teachers adhering to the pacing guide for instruction and supporting teachers with division initiatives and new technology trainings. The group did not place participating in curriculum development teams or attending professional development opportunities for content-areas they supervised in a high priority on the q-sort either.

The role of instructional leaders is to influence the teaching and learning in their schools, but without sufficient knowledge of the content it would be difficult to understand the new science practices, and for administrators in this group to give constructive observational feedback to teachers to improve instruction. Administrators need to be able to identify science practices in the classroom and giving teachers feedback that will promote teacher self-efficacy. For this group of administrators to be able to have accurate student data-driven conversations with teachers then administrators need instructional knowledge and pedagogical skills (Zepeda, 2012).

Q-Sort Findings in the Context of the Literature

Many of the findings were consistent with the literature review in different factors. Some factors were inconsistent with some of the elements of effective feedback and support for secondary science teachers. Participants rejected some statements that were developed during the pilot study phase. This section examines the similarities and differences of the findings with the extant literature. Statements 18 and 32, which were developed based on my review of relevant extant literature, were accepted by the participants (Table 27).

Table 27

Statements From the Literature Accepted by Participants

Statement	Source	Factor A	Factor B	Factor C
Encourage teachers to have positive teacher-student relationships.	Savran & Çakiroglu, 2003	+4	+4	0
Encourage teachers to set high expectations for all students.	Marshall, 2009	+2	+4	+2

Statement 18, encourages teachers to have positive teacher-student relationships. That statement ranked the highest for Factor A and B groups. The exception was the perspective of Factor C on positive teacher-student relationships. In the focus group interviews, the participants in Factor C stated that they felt that teachers having higher expectations for students was better than teacher-student relationships. That group placed a higher value on monitoring and using evidence for conversations with teachers than building positive teacher-student relationships. This statement was a neutral sort for this factor.

Statement 32, encourage teachers to set high expectations for all students. That statement ranked highly with Factor B (+4); however, Factors A and C ranked it on the positive side of the distribution (+2) but at a lower priority. In the focus group interviews, participants in Factor B, Participant 7 stated, "I was looking at teachers needing to have high expectations and relationships with their students" (personal communication, February 4, 2021). Factors A and C stated that this was a priority, but it did not influence their work as much as other areas. Some of the findings were not consistent with the literature and were rejected. Participants rejected Statements 9 and 37 (Table 28). Statement 9 ranked the low for all three factor groups. In the focus group interviews, participants in Factor A share with their teachers how much they are appreciated and demonstrate it in other ways, but they did not write appreciation notes. The groups placed higher values on other aspects of supporting teachers, such as encouraging positive teacher-student relationships. This statement was a negative sort for this factor. Statement 37 was also rejected by the factors during the focus group interviews and received a lowed score from Factor A and B. The concern for Statement 37 being the lowest for Factor A is that this action would help administrators learn more about the new science practices.

Table 28

Statements From the Literature Rejected by Participants

		Factor		
Statement	**Source**	**A**	**B**	**C**
Send my teachers appreciation notes as appropriate.	Brookhart & Moss, 2015	-3	-2	-2
Participate on the curriculum development team for the area that I supervise.	Wahlstrom & Louis, 2008	-4	-3	-1

Post-Sort Interview Emerging Themes

There were significant similarities and differences among the three factor groups. Participants in all factors shared similarities on setting high expectations for all students, emphasizing effective instructional practices to teachers, and encouraging positive teacher-student relationships (higher for Factor A and B). Differences between the factors emerged when looking at effective actions of administrators. Some found attending collaborative learning team meetings effective while others felt that providing students with opportunities to collaborate and engage in academic discourse was more effective. The group with the most administrators who had a science background felt that effective support for them would be encouraging teachers to use a lot of hands-on activities with student collaboration. Hands-on and investigating practices are an important starting point but given recent reforms to state and national science standards, those are not enough to address all of the changes. Based on this study, administrators with experience teaching science or those that had been an administrator longer than 10 years more easily noticed science practices specifically the investigating practice. Administrators with a science background or more experience as a secondary administrator are more familiar with science practices which suggests they would benefit from a different support that would focus on sensemaking and critiquing practices that are needed to support them with identifying science practices in the classroom. The other administrators would benefit from support that would target all three science practices. Administrators need support to visualize what a classroom that engages in the science practices should look like, why that instruction should be different, and how they can support their teachers (McNeill et al., 2018).

Administrators need support through their social networks at the school, district and state levels. The science reforms created an occasion for sensemaking to occur. Individuals do not develop reform beliefs as individuals; they seek out their peers to engage in those discussions and then formulate shared understandings (Coburn, 2001; Siciliano et al., 2017). Sensemaking is a social process and local social networks are the ones that will shape how teachers implement reforms. Administrators also need those social networks to be able to lead their teachers in the correct direction. That was seen during the post-sort interviews. As administrators were faced with a science lesson video to watch, many felt uncertainty when asked to discuss science practices. When faced with new science reforms administrators may seek out their social networks (e.g., their colleagues) for an opportunity to discuss their concerns and implementation processes.

Seeing Science-Specific Elements of Instruction

One of the first themes that emerged was based on the science clip and the responses that administrators gave to what they noticed during the lesson. When observing and discussing the science clip, science specific elements, investigating practices, sensemaking, and critiquing practices were not common in administrators' noticing responses. Most focused-on classroom management, student engagement, and other pedagogical practices. A potential cause of this pattern could be the selected video; the video might need to be longer for some administrators. The study was conducted under unique conditions that required modifications, such as the class being taught via Zoom and the length of the video being shortened. This could be addressed in future research that might be able to be conducted in person. Another explanation for the focus of the pedagogy might be that the administrators lack expertise in science, since only six of the administrators reported teaching science before becoming an administrator. Only three of those taught science in the last 5 years. An administrator's understanding of science will significantly impact their instructional leadership (Spillane, 2005). Also, observation protocols typically used by districts and school-based administrators focus on general pedagogical models and student engagement (Zepeda, 2012).

Science Practices in Administrator Feedback

The next theme that emerged looked at the science practices that were evident in administrator feedback. Science reform shifted from science inquiry to science practices because inquiry was aligned with experiments and hands-on activities (Osborne, 2014). This was seen in the q-sort and during the interviews with Factor A (highest number of administrators with science backgrounds), where administrators ranked "encouraging teachers to use a lot of hands-on activities with student collaboration" highly (+3) on the distribution grid. Instructional leaders often make sense of education reforms based on their prior experiences (Spillane, 2004). Administrators who were not trained in science practices might be more familiar with other instructional models. The type of instruction that supports argumentation is very different from active investigation, both of which are used in this school district. The Argument Driven Inquiry model focuses on student-centered learning that is authentic to the discipline (Sampson et al., 2013). Not all administrators attend these various trainings or hold that in high priority, as is evident on q-sort statement #39 which sorted as a -3 for Factor A, 0 for Factor B, and 1 for Factor C. This could explain why administrators did not recognize that students need to engage in argumentation from evidence, evaluate information, or question and evaluate each other's ideas (NRC, 2012). The students also need to investigate, collect data and make sense of the data. This was not mentioned in the feedback nor was it recognized by all administrators when they watched the science video clip. Only three administrators (Participants 5, 19, and 15; 21%) mentioned in their feedback that they would suggest the teacher have the students conduct another investigation and share the data with their classmates. Two administrators (Participants 7 and 13; 14%) suggested the teacher needed to put the students in breakout groups and allow them to engage in academic discourse on heat transfer.

A Future Vision Needed

The final theme that emerged looked at the need for administrators to understand science practices. The theme emerged from the science practices that were missed by the administrators in their questionnaires or interviews. This is particularly important at the secondary level since many disciplines of science at this level are complex content areas. The science practices give the administrator a lens that they can apply across multiple curricula. Administrators need a vision of science that aligns the new science standards with what is being taught and assessed. The three science practice areas (investigative, sensemaking, and critiquing) are a good foundational point for administrators. The goal is to give administrators a starting point that they can use across the different disciplines in science. This will support systemic change that will positively affect science teachers' instruction and student achievement in science.

Implications

School Level

Science education is a complex system and that stems from multiple layers of influence from the classroom, school, district, state, and national levels (NRC, 2012). These all influence decision making on science education and the classroom instruction (McNeill et al., 2018). Leadership at all levels is needed to move the vision of science instruction forward as laid out in NGSS and 2018 Virginia Science Standards of Learning (NRC, 2015; VDOE, 2018). Science teachers make instructional decisions that affect what students learn in science. School administrators make decisions about what effective science instruction should look like in their building, which influences teachers' instruction and students' learning of science (Wenner & Settlage, 2015). Yet administrators often have a limited understanding of science practices (McNeill et al., 2018). Findings from the current study substantiated that claim and showed that participating secondary administrators tended to focus on pedagogy when observing science instruction rather than offering specific feedback on science practices. To promote science reforms that are aimed at improving students' learning of science content, administrators need to be able to provide specific feedback to each discipline (Hill & Grossman, 2013). Findings from the current study suggest that administrators need help to develop their capacity to effectively support science instruction that reflects the science practices. Administrators need the ability to understand science practices, recognize effective science instruction, and offer support to teachers.

These findings also suggest that administrators need support to become effective instructional leaders in science. That support is needed to enable the administrators to provide their teachers with effective feedback that will improve science instruction. Administrators need support in building their capacity to notice science practices when they observe a teacher and also to develop administrators' understanding of effective science instruction. This could be addressed by having an observation protocol that is specific to science and would include a focus on the science practices. Given that some administrators have a science background and others do not, specific training might be needed to ensure that all administrators understand investigative, sensemaking, and critiquing practices.

District Level

The 2019-2020 school year ushered in many challenges and opportunities for science instruction. One of these challenges was conducting science investigations during remote and virtual instruction; that was addressed by creating individual science kits for every student in the tested grades. Teachers needed to be adaptable and ready to lead their classes through investigations in a virtual environment. This led to using video of science classrooms with different student groups. This study featured a video of a science classroom and had administrators reviewing it for science practices and good science instruction. As instruction moves forward amid a pandemic, the idea of traditional school and science classes are things of the past. Administrators will need support in observing and evaluating science practices by watching teachers livestream videos and providing effective feedback to teachers that improves science instruction.

Another implication at the district level is the how administrators will process and implement the needed changes for science. In Chapter 2, sensemaking theory in organizations is an important focus to look at the perceptions of administrators because it looks at how people make sense of their reality (Weick, 1995; Carraway & Young, 2015). This is important for this study as it revealed three factors for the secondary administrators within a district. These groups of administrators had some similarities and many differences in their perceptions of their instructional leadership roles and how they support teachers specifically science teachers. An implication of this study was the need for secondary administrators to receive training on identifying science practices and supporting the new science standards that will be assessed being next school year. By understanding the perceptions of the administrators would allow the district to begin offering professional development to address the needs of the administrators. Administrators have numerous duties that take them away from their instructional duties and having a support system where administrators have identified colleagues that they can collaborate with and process these changes will allow for an effective implementation districtwide.

State Level

Instructional leaders need professional development to support their understanding of the science practices and new science standards. There are state-level training sessions for teachers on the new science standards; administrators need ongoing training as well. The inclusion of the science and engineering practices in the new science standards for the state brings the gap in content and instructional practices to the forefront for administrators. Administrators need to provide strong instructional leadership in their schools and support teachers to improve instruction and increase student achievement (Leithwood et al., 2004). To ensure that teachers integrate the science practices in their instruction for all students, administrators need to receive that training as well (NRC, 2012). Administrators must expand their social networks to at least ensure that their members have the proper training acquired to make informed decisions. When faced with new policies or unfamiliar situations, educators will seek out their colleagues for discussion to help reduce their uncertainty, and that will provide the foundation for their social network (Siciliano et al., 2017).

As administrators and teachers expand their social networks, the policy and implementation of the new science standards will become easier to ensure it is occurring in schools. This will translate into students receiving instruction that will help them develop a passion or foundation to pursue a career in a STEM-related field (Fayer et al., 2017). Science is one of the performance areas for accountability and the implementation of the new science practices will help schools ensure they meet accreditation goals (VDOE, 2019). Given the change in Virginia's accountability mentioned in Chapter 1, and the new 2018 science standards that will be assessed in Spring 2023, these suggestions must be addressed immediately. The state recommends that the 2010 science standards and 2018 science standards be taught in all science classrooms this school year. In Spring 2022 the 2010 science standards will be assessed with field test items from the 2018 science standards (VDOE, 2019).

Higher Education

Educational leadership programs in higher education must consider the educational reforms that administrators will encounter and design curriculum that ensures their candidates receive diverse content training, either as an elective course or in a more general manner that will lead administrators to seek out the additional training from the district or state. None of the three factor groups in this study provided high rankings for "learning from content specialists in the district," "working on the curriculum development team," or "attending trainings for content-areas." Participants did not find Statements 7, 37, or 39 represented their perception of supportive and effective actions that they should provide to their teachers (Table 10). Statement 7, "partner with curriculum specialists/supervisors," was ranked as 0 for Factor A, 1 for Factor B, and -1 for Factor C. That meant that only Factor C group ranked this action on the negative side of the distribution grid, and it was lowly ranked. Statement 37, "participate on the curriculum development team for the area that I supervise," was ranked on the negative side for all factor groups. That statement was ranked at a -4 for Factor A, which was the lowest score possible. Factor B ranked it at -3 and Factor C at a -1. This action was not seen as an influential value by the administrators. Statement 39, "attend professional development opportunities for content-specific areas" also received low rankings (Factor A, -3; Factor B, 0; and Factor C, 1). Given that administrators have a responsibility to support all content areas regardless of their expertise, and an administrator is vital to high-quality science instruction, this focus must be included in the leadership courses for aspiring administrators (Sergiovanni et al., 2013; Wenner & Settlage, 2015).

Future Research

The study could be replicated during in-person instruction with the same or different administrators. That research would include shadowing administrators on visits to science classrooms to observe their instructional leadership in practice, observing administrators as they conduct debriefs with teachers after a classroom observation, or visits to the administrators' schools as they lead or supervise a science training with their teachers. A limitation of this study was that it was conducted during a pandemic and the school system was in a virtual setting, which did not allow for in-person visits to classrooms. The same study could also be conducted with a different department, such as mathematics in the secondary classroom. The value of this research would be to show any similarities or differences that may exist at the district level on the emphasis placed on different disciplines.

The same study could be conducted in another district within the state or multiple school districts in the same state. This study conducted in other school districts within the state would provide the researcher with additional data to compare the findings. This study could be replicated in a different state and look at their science standards and determine any differences. Another approach would be to take the study to another country to look at science practices around the globe.

Another future research area that could grow out of this study is the Swivl robot as a way for administrators to provide feedback and gain knowledge in the science practices. As a result of the pandemic and students returning to school in a hybrid environment, the district purchased Swivl robots for all of their secondary teachers. This hybrid environment required teachers to teach students at home and in-person simultaneously. The Swivl robot is a tool that follows the teacher around the room which allows them to move freely around the classroom for instruction, which was particularly important for science teachers, who need to engage their students in investigative practices. When some students return to school and others remain virtual, the robots will also allow teachers to host hybrid classes where student groups will include in-person and virtual learners simultaneously working together. This will allow the teachers to engage in the sensemaking and critiquing practices even in a hybrid classroom. This study featured a video of a science classroom and had administrators reviewing it for science practices and good science instruction.

This study could continue to expand, and another future study would be to look at the development and the implementation of an observational tool used by administrators that focuses on key elements of science instruction. The study could also look at administrators' experiences using video or live streaming of science lessons to provide effective feedback and support for science teachers. A self-reporting tool could also be designed to allow teachers to rank themselves and then discuss and share with other that will increase their self-efficacy as well.

Conclusions

This study was designed to explore the relationship between the structure and focus of an administrator's instructional roles and their capacity to foster quality science support and instructional feedback for teachers and students. I sought to gain an in-depth understanding of administrators' perceptions of effective actions that support teachers and evidence that they could recognize science practices in the classroom and support science teachers. In Chapter 5, the findings are discussed and linked with the literature. This chapter also presented implications for science reform at the school, district, and state levels. Future research was also addressed that would expand the scope of the research.

Administrators' perceptions of effective support actions were captured from Q-Methodology sorts, post-sort questionnaires, and focus group interviews, which are part of the InQuiry research method. The questionnaire responses and interviews were also used to explore what administrators noticed during a science lesson and the type of feedback and support they would provide that teacher. Both qualitative and quantitative data were used to gain an understanding of the subjective opinions of the participants. The data analysis produced three factors. The factor names were selected based on the statistical characteristics of the highly ranked statements, common themes that emerged from the post-sort survey questions, and the focus group interviews. The three factors are: Effective Encouragers (Factor A), R.E.C. League (Relationships, Encouragement and Curriculum; Factor B), and Eye in the Sky (Factor C).

The findings in this study were consistent with the literature on instructional leadership and science practices. Participants felt the need for positive teacher-student relationships, and having high expectations for all students, but how they went about supporting their teachers was very different. Their perspectives were different, but they all held high expectations for teachers and students. They also felt strongly about their role in providing instructional leadership. It is evident that there is a need for increasing administrators' understanding of science practices. An educational systems model that includes a pathway for administrators at different levels of experiences to receive science practices training is needed.

The traditional K-12 science education system has endured longer that the new science practices reform efforts that were discussed in this study. As a result, implementing the science practices will require a combined effort with practitioners, higher education and the state level science administrators. This study was a first step in understanding how administrators identify science practices and their actions to support science teachers in the classroom. The study suggested that the key role of instructional leaders for science is being able to identify science practices and support teachers and students on implementing them in the classroom. Using the constructed q-sort that was created in this study allowed participants to be grouped by their shared perceptions in an administrator's capacity to support science instruction. This q-sort allows them to reflect and make sense of their role as an administrator who supports science instruction. Therefore, partnerships with higher education, science specialists at the division and state levels need to be developed to increase an administrator's capacity to identify and support the implementation of science practices and science reform. Greater attention needs to be given to sensemaking during this process as organizational change is the goal. As administrators are being introduced to the science practices allowing them to remain in their factors will ensure a deeper understanding of the concepts. Sensemaking is how individuals fit new knowledge into their existing frameworks. Those existing frameworks are based on prior learned ideas and experiences which shape the perceptions of the administrators that were evident in the current study.

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APPENDIX A: Q SORT PROTOCOL

Title of Research Study: Administrator's Experiences & Practices Supporting Science Instruction

Principal Investigator: Dr. Karen Sanzo **Investigator**: Venicia Ferrell

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Please provide a unique identifier that you were given:_________________________

Condition for Sorting the Statements—keep this statement in mind as you sort the statements: *"What is the most effective feedback that your teachers need right now to help them move their classroom instruction forward?"*

Q Sort Instructions:

1. You will click the link and log in with your unique identifier the statements will be displayed and you will see a continuum with the negative (-) numbers on your left and positive numbers on the right (see picture below):

2. Read through all **40** statements to become familiar with the statements.

3. As you read through the statements for a second time, organize them into three piles:

   - On the right, drag the cards that you feel are **most representative of what you believe are examples of the most effective feedback and support for teachers to move their instruction forward.**
   - On the left, drag the cards that are least representative.
   - In the middle, place the cards that you feel less certain about.
4. Beginning with the statements on the right, drag the **three** statements that you **agree** with the most under the **+4** marker.

5. Now, look to your left side, drag the **three** cards that you **disagree** with the most under the **-4** marker.

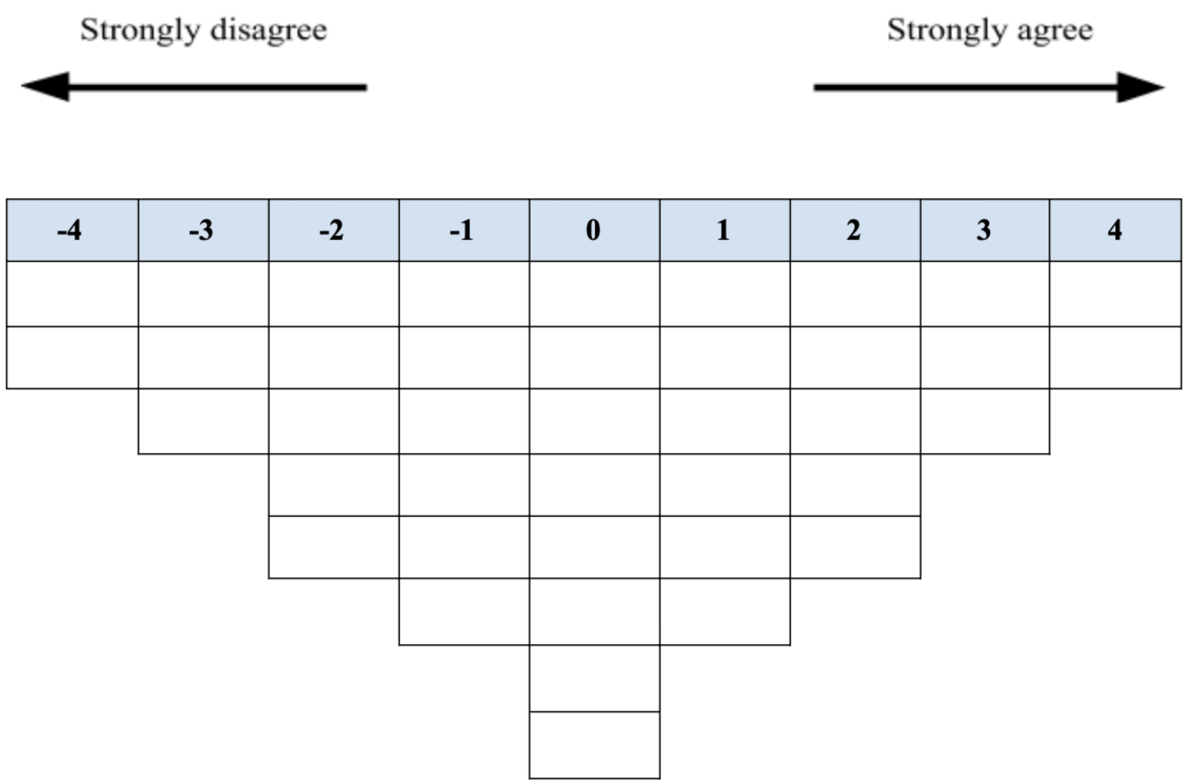
6. Continue this process until all the cards are placed. You are free to change your mind during the sorting process and switch items around.

7. When completed, you should have the following number of cards under each row:

   - You should have a total of **4** cards under markers **+4** (most **agree**) and -4 (least **agree**).
   - You should have a total of **6** cards under markers **+3** (**agree**) and -3 (**disagree**).
   - You should have a total of **10** cards under markers **+2** (slightly **agree**) and -2 (slightly **disagree**).

- You should have a total of **12** cards under markers **+1** (slightly **agree**), and -1 (slightly **disagree**).
- You should have a total of **8** cards under marker 0 (neutral).

8. Your sorted cards should match the diagram below. After sorting the cards, be sure to hit submit to ensure that your selection has been recorded. **KEEP YOUR RESPONSES ON THE SCREEN**—you will need them to answer the follow-up questions.



<u>Post Q Sort Interview Questions:</u>

1) Please list a few of the statements you placed in the +4 column and your reasons for placing them there.

Statement #:______

Statement #:______

2) Please list a few of the statements in the -4 column and your reasons for placing them there.

Statement #:______

Statement #:______

3) Were there specific statements that you had difficulty placing? *Choose one and please list the number of the statement and describe your dilemma.*

Statement #:______

5) Is there a statement that you would have liked to add to the sort? If so, what would the card have said and where would you have placed it?

6) In order, what are the three most effective feedback statements or support that you can give your teachers? Why are they important and how could you ensure that they are well received by your teachers?

7) Would you be willing to participate in a post-sort focus group interview?

APPENDIX B: POST-SORT FOCUS GROUP PROTOCOL

Title of Research Study: Administrator's Experiences & Practices Supporting Science Instruction

Principal Investigator: Dr. Karen Sanzo **Investigator**: Venicia Ferrell

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Please provide the unique identifier that you were given:_________________________

Participants with significant loading on a particular factor will join other participants who loaded on the same factor. Loading on a common factor represents a statistically significant shared perspective. The group will watch a short 2-3 minute clip of a secondary science teacher delivering a lesson to students virtually. The purpose of this focus group interview is to gain additional insights about why participants have their perspectives, and how those perspectives influence their feedback to teachers.

After performing factor analysis on all of the responses, your responses are statistically similar to those shown in the model sort.

Condition for Sorting the Statements—as a reminder, keep this statement in mind as you participate in the focus group interview process: *"What is the most effective feedback that your teachers need right now to help them move their classroom instruction forward?*

1) Who is in your group? Describe any similarities and/or differences (e.g., demographics, job, etc.).

2) Which statements best represent your shared perspective?

3) What has had the greatest impact on how you sorted your cards the way you did? (Examples- past experience, administration training, content knowledge, etc.). Please explain your answers.

4) What name would you assign that represents the perspective illustrated by this model sort? Explain why and the meaning associated with that name—use statements to provide justification for your name.

5) What did you “notice” during the science lesson?

6) Based on your perceptions of the most effective feedback, what feedback would you provide to this teacher regarding science instruction?

APPENDIX C: STATEMENT SORT CONSENT FORM
OLD DOMINION UNIVERSITY

Title of Research Study: Administrator's Experiences & Practices Supporting Science Instruction

Principal Investigator: Dr. Karen Sanzo **Investigator**: Venicia Ferrell

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The purposes of this form are to give you information that may affect your decision whether to say YES or NO to participation in this research, and to record the consent of those who say YES.

Why am I being invited to take part in this research?
The purpose of this study is to seek to understand what elements of the most effective feedback and support that can be provided to teachers to help them move their instruction forward. As a current or recent secondary administrator, you are being invited to take part in this research to seek your perceptions, viewpoints, and insights about how you successfully deliver feedback and support teachers. You are being asked to take part in the study by participating in a Statement Sort Exercise. Your participation in this study is voluntary. The decision to take part in the research is yours to make. You have the right to participate, to choose not to participate or to stop participating at any time without penalty. By conducting this research, we hope to obtain findings to the following research questions:

1. What are secondary school administrators' perceptions of effective support and feedback to classroom teachers?
2. What do secondary administrators "notice" when watching science instruction?
3. How comfortable are secondary administrators at supporting and delivering effective feedback in science classrooms?

If you volunteer to participate in this research, you will be one of about 30 people to do so.

Are there reasons I should not take part in this research?
You should not participate in this research study if you are less than 18 years old. There are no known risks to participating in the card sorting exercise.

What other choices do I have if I do not take part in this research?
You can choose not to participate.

Where is the research going to take place and how long will it last?
The research will be conducted virtually using a tool such as Zoom. The total amount of time you will be asked to volunteer for this study is approximately one hour.

What will I be asked to do?
You will be asked to sort 40 cards. These statements are about effective feedback and support for teachers and your task will be to sort them according to your own beliefs and viewpoints. This process should take approximately 30-40 minutes. After sorting the statements, you will be asked to complete a brief questionnaire about the statements and why you placed specific statements in certain areas on the distribution grid. In addition, you will be asked some general demographic data. Your sort and your responses to the questionnaire will remain confidential.

What might I experience if I take part in the research?
We do not know of any risks (the chance of harm) associated with this research. Any risks that may occur with this research are no more than what you would experience in everyday life. We do not know if you will benefit from taking part in this study. There may not be any personal benefit to you but the information gained by doing this research may help others in the future.

Will I be paid for taking part in this research?
We will not be able to pay you for the time you volunteer while being in this study.

Will it cost me to take part in this research?
It will not cost you any money to be part of the research.

Who will know that I took part in this research and learn personal information about me?
ODU and the people and organizations listed below may know that you took part in this research and may see information about you that is normally kept private. With your permission, these people may use your private information to do this research:

- Any agency of the federal, state, or local government that regulates human research.
- The University & Medical Center Institutional Review Board (UNCIRB) and its staff have responsibility for overseeing your welfare during this research and may need to see research records that identify you.

How will you keep the information you collect about me secure? How long will you keep it?
The information in the study will be kept confidential to the full extent allowed by law. Data will be stored securely on a computer and in a location of which only the researcher has access. No reference will be made in oral or written reports that could link you to the study.

What if I decide I do not want to continue in this research?
You can stop at any time after it has already started. There will be no consequences if you stop and you will not be criticized. You will not lose any benefits that you normally receive.

If at any time you feel pressured to participate, or if you have any questions about your rights or this form, then you should call Dr. Tancy Vandecar-Burdin, the current IRB chair, at 757-683-3802, or the Old Dominion University Office of Research, at 757-683-3460.

Who should I contact if I have questions?
The people conducting this study will be able to answer any questions concerning this research, now or in the future. You may contact the Investigator at phone number 757-593-6631 (M-F, 9:00 am – 4:00 pm) or email vferr001@odu.edu

I have decided I want to take part in this research. What should I do now?
The person obtaining informed consent will ask you to read the following and if you agree, you should sign this form:

- I have read (or had read to me) all of the above information.
- I am at least 18 years old.
- I have had an opportunity to ask questions about things in this research I did not understand and have received satisfactory answers.
- I know that I can stop taking part in this study at any time.
- By signing this informed consent form, I am not giving up any of my rights.
- I have been given a copy of this consent document, and it is mine to keep.

Participant's Name (PRINT) Signature Date

Person Obtaining Informed Consent: I certify that I have explained to this subject the nature and purpose of this research, including benefits, risks, costs, and any experimental procedures. I have described the rights and protections afforded to human subjects and have done nothing to pressure, coerce, or falsely entice this subject into participating. I am aware of my obligations under state and federal laws, and promise compliance. I have answered the subject's questions and have encouraged him/her to ask additional questions at any time during the course of this study. I have witnessed the above signature(s) on this consent form.

Person Obtaining Consent (PRINT) Signature Date

APPENDIX D: FOCUS GROUP CONSENT FORM
OLD DOMINION UNIVERSITY

Title of Research Study: Administrator's Experiences & Practices Supporting Science Instruction

Principal Investigator: Dr. Karen Sanzo **Investigator**: Venicia Ferrell

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The purposes of this form are to give you information that may affect your decision whether to say YES or NO to participation in this research, and to record the consent of those who say YES.

Why am I being invited to take part in this research?
The purpose of this study is to seek to understand what elements of the most effective feedback and support that can be provided to teachers to help them move their instruction forward. As a current or recent secondary administrator, you are being invited to take part in this research to seek your perceptions, viewpoints, and insights about how you successfully deliver feedback and support teachers. You are being asked to take part in the study by participating in a Post-Sort Interview. Your participation in this study is voluntary. The decision to take part in the research is yours to make. You have the right to participate, to choose not to participate or to stop participating at any time without penalty. By conducting this research, we hope to obtain findings to the following research questions:

1. What are secondary school administrators' perceptions of effective support and feedback to classroom teachers?
2. What do secondary administrators "notice" when watching science instruction?
3. How comfortable are secondary administrators at supporting and delivering effective feedback in science classrooms?

If you volunteer to participate in this research, you will be one of about 30 people to do so.

Are there reasons I should not take part in this research?
You should not participate in this research study if you are less than 18 years old. There are no known risks to participating in the card sorting exercise.

What other choices do I have if I do not take part in this research?
You can choose not to participate.

Where is the research going to take place and how long will it last?
The research will be conducted virtually using a tool such as Zoom. The total amount of time you will be asked to volunteer for this study is approximately one hour.

What will I be asked to do?
You will be asked to sort 40 cards. These statements are about effective feedback and support for teachers and your task will be to sort them according to your own beliefs and viewpoints. This process should take approximately 30-40 minutes. After sorting the statements, you will be asked to complete a brief questionnaire about the statements and why you placed specific statements in certain areas on the distribution grid. In addition, you will be asked some general demographic data. Your sort and your responses to the questionnaire will remain confidential.

What might I experience if I take part in the research?
We do not know of any risks (the chance of harm) associated with this research. Any risks that may occur with this research are no more than what you would experience in everyday life. We do not know if you will benefit from taking part in this study. There may not be any personal benefit to you but the information gained by doing this research may help others in the future.

Will I be paid for taking part in this research?
We will not be able to pay you for the time you volunteer while being in this study.

Will it cost me to take part in this research?
It will not cost you any money to be part of the research.

Who will know that I took part in this research and learn personal information about me?
ODU and the people and organizations listed below may know that you took part in this research and may see information about you that is normally kept private. With your permission, these people may use your private information to do this research:

- Any agency of the federal, state, or local government that regulates human research.
- The University & Medical Center Institutional Review Board (UNCIRB) and its staff have responsibility for overseeing your welfare during this research and may need to see research records that identify you.

How will you keep the information you collect about me secure? How long will you keep it?
The information in the study will be kept confidential to the full extent allowed by law. Data will be stored securely on a computer and in a location of which only the researcher has access. No reference will be made in oral or written reports that could link you to the study.

What if I decide I do not want to continue in this research?
You can stop at any time after it has already started. There will be no consequences if you stop and you will not be criticized. You will not lose any benefits that you normally receive.

If at any time you feel pressured to participate, or if you have any questions about your rights or this form, then you should call Dr. Tancy Vandecar-Burdin, the current IRB chair, at 757-683-3802, or the Old Dominion University Office of Research, at 757-683-3460.

Who should I contact if I have questions?
The people conducting this study will be able to answer any questions concerning this research, now or in the future. You may contact the Investigator at phone number 757-593-6631 (M-F, 9:00 am – 4:00 pm) or email vferr001@odu.edu

I have decided I want to take part in this research. What should I do now?
The person obtaining informed consent will ask you to read the following and if you agree, you should sign this form:

- I have read (or had read to me) all of the above information.
- I am at least 18 years old.
- I have had an opportunity to ask questions about things in this research I did not understand and have received satisfactory answers.
- I know that I can stop taking part in this study at any time.
- By signing this informed consent form, I am not giving up any of my rights.
- I have been given a copy of this consent document, and it is mine to keep.

Participant's Name (PRINT) Signature Date

Person Obtaining Informed Consent: I certify that I have explained to this subject the nature and purpose of this research, including benefits, risks, costs, and any experimental procedures. I have described the rights and protections afforded to human subjects and have done nothing to pressure, coerce, or falsely entice this subject into participating. I am aware of my obligations under state and federal laws, and promise compliance. I have answered the subject's questions and have encouraged him/her to ask additional questions at any time during the course of this study. I have witnessed the above signature(s) on this consent form.

Person Obtaining Consent (PRINT) Signature Date

APPENDIX E: RECRUITMENT EMAIL
OLD DOMINION UNIVERSITY

Title of Research Study: Administrator's Experiences & Practices Supporting Science Instruction

Principal Investigator: Dr. Karen Sanzo **Investigator**: Venicia Ferrell

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Dear Recipient:

Hello, my name is Venicia Ferrell and I am a Science Curriculum Leader for a public school system and a doctoral student in the Department of Educational Foundations & Leadership at Old Dominion University. As part of my doctoral dissertation, I am conducting a research study to understand secondary administrators' perceptions of effective feedback for teachers and how they support and move instruction forward in the area of science. I am recruiting secondary administrators who support and provide feedback to teachers.

Participation in this study will take approximately 60 minutes. If you would like to participate, I will ask that you respond to me via email and complete a brief background questionnaire on your administration experiences (approximately 5 minutes).

Participation is voluntary and there are no consequences for choosing not to participate or withdrawing from the study. The confidentiality of all participants will be maintained. The data will be kept secure and password protected.

Any additional questions regarding this project should be directed to me, Venicia Ferrell, at vferr001@odu.edu. Please respond to this email if you're interested in participating in this study.

Venicia Ferrell
Doctoral Student
Old Dominion University