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The Perceptions and Experiences of Elementary Georgia Science Ambassadors: What Educational Leaders and Policymakers Need to Know

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ACCEPTANCE

This dissertation, THE PERCEPTIONS AND EXPERIENCES OF ELEMENTARY GEORGIA SCIENCE AMBASSADORS: WHAT EDUCATIONAL LEADERS AND POLICYMAKERS NEED TO KNOW, by CHARLES HARPER, was prepared under the direction of the candidate's Dissertation Advisory Committee. It is accepted by the committee members in partial fulfillment of the requirements for the degree, Doctor of Education, in the College of Education & Human Development, Georgia State University.

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THE PERCEPTIONS AND EXPERIENCES OF ELEMENTARY GEORGIA SCIENCE

AMBASSADORS: WHAT EDUCATIONAL LEADERS AND POLICYMAKERS

NEED TO KNOW

by

CHARLES HARPER

Under the Direction of Dr. Sheryl Cowart Moss

ABSTRACT

The purpose of the study was to characterize the Georgia Science Ambassadors Program (GSAP)

by investigating the perceptions and experiences of elementary-level (K-5) Georgia Science

Ambassadors (GSA). The GSAP was instituted to augment the leadership capacity of science

educators across the state and to support the implementation of the new Georgia Standards of

Excellence (GSE) for Science. The study explored GSA's perceptions about how the relative

distribution of leadership and support has influenced their ability to lead GSE implementation.

A sample of 15 elementary-level ambassadors was purposively selected for the study. Data were

gathered through semi-structured interviews and document analysis. Data analysis was

conducted within a theoretical frame of distributed instructional leadership and systems theory.

A combination of provisional, structural, and values coding was used to identify emergent themes and patterns. The findings suggested that elementary-level GSA have been largely marginalized by principals. Distribution of leadership and support to the elementary science ambassadors has been sparse and inconsistent. Even in rare cases when leadership and support were distributed to ambassadors, it was oftentimes mediated by other factors, such as time constraints, conflicting priorities, and teachers' receptivity of the GSE. Ambassadors' perceptions and experiences generated insights and recommendations for improving the program, orchestrating similar policy endeavors, and leading the implementation of reform-based science standards. A summary and discussion of the findings include limitations of the study, suggestions for future lines of inquiry, and the theoretical, practical, and policy implications of the study.

THE PERCEPTIONS AND EXPERIENCES OF ELEMENTARY GEORGIA SCIENCE

AMBASSADORS: WHAT EDUCATIONAL LEADERS AND POLICYMAKERS

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CHARLES HARPER

A Dissertation

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Degree of

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in

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in

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DEDICATION

To my family. You are the light of my life. Keep shining, smiling, and laughing.

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CHAPTER 1

THE CASE OF THE GEORGIA SCIENCE AMBASSADORS PROGRAM

A pioneering approach has been underway to promote inquiry-based science instruction in Georgia schools. The Georgia Science Ambassadors Program (GSAP) was instituted in 2016 to help implement the newly adopted Georgia Standards of Excellence (GSE) for Science. The goal of the GSAP was to support the implementation of the new standards by augmenting the leadership capacity of science educators across the state (Georgia Department of Education, 2016b). The program was an innovative merger of distributed instructional leadership (Harris, 2007; Klar, 2012; Halverson & Clifford, 2013) and policy implementation. A corps of 299 Georgia Science Ambassadors (GSA), including 74 elementary-level ambassadors, were trained by the Georgia Department of Education (GADOE) and commissioned as instructional leaders to implement the reform-based science standards. This case study investigated the perceptions of elementary-level science ambassadors about the leadership that has been distributed to them and the types and levels of support they have received.

Guiding Questions

The following two research questions guided the study, governed my efforts, and permeated every stage and aspect of the investigation:

1. What are the perceptions and experiences of Georgia Science Ambassadors about the distribution of leadership and support and how it has influenced their ability to lead the implementation of the Georgia Standards of Excellence (GSE) for Science?

2. How do Georgia Science Ambassadors describe the levels and types of support they have received for implementing the new Georgia Standards of Excellence (GSE) for Science?

The research questions emanated from my active participation in the GSAP. They were crafted

to discern whether specific opportunities and challenges are inherent in the GSE policy initiative,

to spark discourse about the program's overall integrity, and to generate qualitative data that

could ultimately benefit the GSAP. The GADOE is using a research-based, data-informed,

continuous improvement cycle to measure and improve the Science Ambassador Professional

Learning initiative (Tio, 2018), so the empirical findings of the case study may contribute to that

cycle.

Definition of Terms

1. Boundary Spanning: The formal and informal processes of obtaining, filtering, and
   transmitting information across and within organizational boundaries by select
   individuals (Aldrich & Herker, 1977; Tushman & Scanlan, 1981). This report will
   reference boundary spanning in terms of boundary spanning individuals, roles, and
   activity.

2. Cognition: A "sensemaking" process by which individuals construct new
   understandings by noticing and interpreting stimuli, and how prior knowledge,
   beliefs, values, experiences, emotions, context, and other variables influence the
   sensemaking process (Spillane, Reiser, & Reimer, 2002). The use of the term
   "cognitive" throughout this report will refer to those related to cognition.

3. Constructivism: Theory of learning which assumes that all knowledge is constructed
   by the learner through contextual experiences and actions performed on objects
   (Savasci & Berlin, 2012; Wheatley, 1991). The use of the term "constructivist" (e.g.,
   beliefs, teaching practices, etc.) throughout this report will refer to those related to
   constructivism.

4. Distributed Instructional Leadership: A leadership approach that uses the concepts and techniques of distributed leadership, which stretches leadership functions and activities over a number of individuals, to create optimal learning environments for students and teachers (Halverson & Clifford, 2013; Spillane, Halverson, & Diamond, 2004).

5. Knowledge Brokers: People that facilitate the mobilization and transaction of knowledge and create connections between researchers and various audiences (Meyer, 2010).

6. Georgia Science Ambassadors Program (GSAP): A program devised by the Georgia Department of Education to augment the leadership capacity of science leaders across the state and provide school systems and schools with the manpower and support necessary to implement the new Georgia Standards of Excellence for Science (Georgia Department of Education, 2016b). The GSAP is composed of science educational leaders that are individually and collectively known and referred to as Georgia Science Ambassadors (GSA).

7. Georgia Standards of Excellence (GSE) for Science: The academic standards-policy in Georgia which represents the foundational knowledge and skills required for all students to develop proficiency in science; the standards integrate the core knowledge to be mastered with the science and engineering practices needed to engage in scientific inquiry and engineering design (Georgia Department of Education, 2016b).

8. Next Generation Science Standards (NGSS): K–12 science content standards designed to help students build a cohesive understanding of science over time by

setting the expectations for what they should know and be able to do (National

Research Council, 2013).

9. General Systems Theory (GST): A transdisciplinary perspective that portrays any

"whole" or system as a complexity of interdependent smaller parts; general systems

theory and systems thinking attempt to solve problems holistically by placing

emphasis on the dynamic interaction of parts and interrelated subsystems that form

the whole (Bridgen, 2017; Banathy & Saybrook, 2003; Mania-Singer, 2017). In this

paper, the use of the term systems thinking (Shaked & Schechter, 2013, 2016, 2018)

will be used to denote the operationalization of systems theory (i.e. recognizing the

interrelationships of components within a whole as opposed to breaking the system

down and focusing on the component parts themselves).

Purpose and Rationale

The principle aim of the study was to characterize the GSAP by describing and analyzing

how elementary-level ambassadors have perceived the distribution of leadership and support for

carrying out their implementation responsibilities. It was an exploratory investigation situated at

the junction of science education reform, distributed instructional leadership, and policy

implementation. A case study methodology was the preferred approach to investigate the GSAP

based on the nature and characteristics of the proposed study (Lincoln & Guba, 1985; Smith,

1978; Stake, 1995; Yin, 2003). Case studies are most appropriate for intense empirical inquiry

that analyzes the particularity and complexity of a contemporary program within an authentic

and important context (Stake, 1995; Yin, 2003).

The GSAP's singularity as an enterprise that melded distributed instructional leadership

with a state policy initiative made it a fascinating target for educational-policy research. Because

of its neoteric blueprint and singularity, the GSAP had not yet been fully explored. Aside from the logical rationale behind the program's inception, little was known about the substantive quality of the GSAP. I recognized a need to move beyond a perfunctory understanding of the GSAP's tactical intent by closely examining the perceptions and experiences of its constituent members. Educational-leadership research was warranted in this case to learn more about the recent and ongoing work of Georgia Science Ambassadors, the purview of the GSAP, and how both coincided with established tenets of effective leadership and support for policy initiatives.

I anticipated that each ambassador's implementation efforts would unfold within a unique policy ecosystem (Biggs, 1993; Bolman & Deal, 2013), a complex and multi-layered network of dynamic and interdependent people, parts, and processes. I also surmised that their outcomes would be largely influenced by, if not wholly dependent on, their leaders' willingness to support the GSAP vision and mission. These notions were so compelling that they spurred the idea for the research and offered a suitable theoretical framework within which the study could be grounded.

Theoretical framework. A theoretical framework based on distributed instructional leadership theory and systems theory was utilized within an interpretivist-constructivists epistemology (Guba & Lincoln, 1994; Denzin & Lincoln, 1998). My preference for using an interpretivist-constructivist epistemology was attuned to my assumption that GSA's work has been inherently interpretative. The theoretical framework was based on four constructs – the definition of the problem, purpose behind the research, significance of the study, and the research questions (Grant & Osanloo, 2014). A combination of distributed instructional leadership theory and systems theory was particularly fitting for several reasons. First, as ambassadors have worked individually and collectively to interpret the new standards,

implement the GSE with fidelity, and transform the pedagogy of science education in Georgia, they have had to rely on the distribution of leadership and support from other individuals (National Academies of Sciences, Engineering, and Medicine, 2019; Stiles, Mundry, & DiRanna, 2017). Secondly, the types and levels of leadership and support which each GSA has received and contributed towards GSE implementation, has manifested within and through a network of systems and subsystems (Andreadis, 2009; Biggs, 1993). According to McLaughlin (2006), policies vary across and within implementing systems and sites, but the policy that ultimately matters is what gets enacted within the system, not what originated externally. Biggs (1993) described education as an ecosystem, a myriad of interacting, multi-leveled systems and subsystems. The ambassadors constitute an organization that acts as a subsystem of the GADOE and its educational system of Georgia, but also interacts with and responds to a multitude of other macro and micro systems (e.g., political, learning management, support, budgetary, beliefs and values, evaluation, etc.).

The formulation of the theoretical framework was precipitated by the research questions and a review of contemporary literature about distributed instructional leadership and systems theory (Andreadis, 2009; Chen & Stroup, 1993; Shaked & Schechter, 2017). In applying the two perspectives, I preliminarily considered and examined potential systems-related functions, including professional learning, support for policy initiatives, power and positionality, boundary spanning and knowledge brokering, and cognitive "sensemaking." The inquiry addressed cognitive and sociocultural perspectives of instructional leadership and support (Coburn, 2005; Honig, 2012) such as social constructionism, social capital (Coburn & Russell, 2008; Frank, Zhao, & Borman, 2004), and the role of language in "sense-making" (Hill, 2006). Indeed, learning standards such as the GSE represent just one component of a complex system, which

includes curriculum, instruction, professional development, and assessment (National Research Council, 2012). Figure 1 depicts the theoretical funneling approach and structural schema I conceived to guide the study. A more complete examination of distributed instructional leadership and systems theory will be presented in the literature review section.

Perceptions and Experiences of Elementary-Level Georgia Science Ambassadors

Interpretivist-Constructivist Epistemology

Distributed-Instructional Leadership

Systems Theory

Data Analysis

Data Analysis

Increased Understanding of the Georgia Science Ambassadors Program
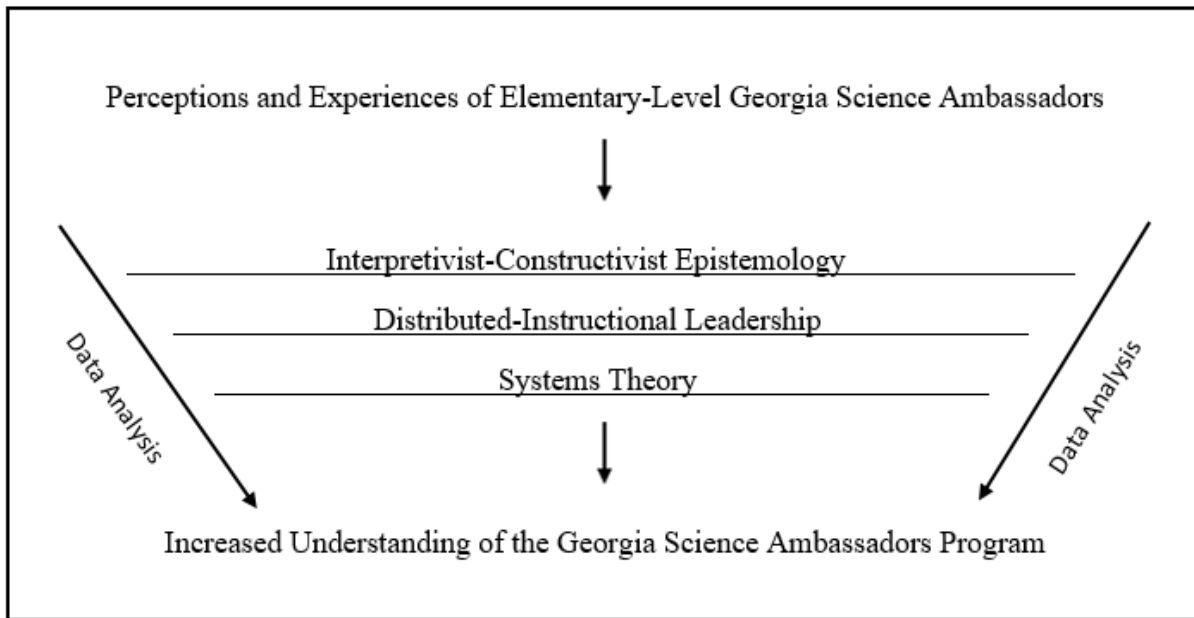
Figure 1. Funneling approach to analyze the Georgia Science Ambassadors Program.

Literature Review

The literature review surveyed a breadth of relevant research findings and provided a framework for analyzing and interpreting the perceptions and experiences of the Georgia Science Ambassadors about leadership and support. It was firmly grounded in the assumption that using multiple theoretical lenses to examine both the process and product of educational policy may help us to better understand and conceptualize the complex issues under study (Cooper, Fusarelli, & Randall, 2004). The literature review focused on three topics that aligned with the study's two research questions. The three categories, which served as analytical and interpretive

filters for exploring the GSAP, included (a) distributed instructional leadership (Harris, 2007; Klar, 2012; Halverson & Clifford, 2013), (b) positionality and power as they relate to boundary-spanning activity (Coldren & Spillane, 2007; Tushman & Scanlan, 1981), and (c) support for achieving policy initiatives (Mac Iver & Farley, 2003). I used these three thematic categories to identify, organize, and analyze obvious and emergent themes that related to ambassadors' work, such as professional learning, cognitive "sensemaking," reform-based science standards, problem-framing, capacity building, authority and discretion, voice and autonomy, etc. The interpretive lenses of distributed instructional leadership, power and positionality, and support for policy initiatives served as the guideposts since they were interrelated and complementary, they contextualized the research questions, and they encompassed other pertinent research-based themes.

The literature base was well established with rich qualitative data that could potentially inform the GSAP and its ambassadors. The Science GSE closely resemble the Next Generation Science Standards (National Research Council, 2013), so research articles related to the NGSS and their implementation were thoroughly reviewed. One particular document, *Framework for Leading NGSS Implementation* (Stiles et al., 2017), emerged as a centerpiece of the review and offered important comparison points for the current study. Considering the comparable nature of the GSE and NGSS, the requisite leadership skills and knowledge for implementing the two standards policies are likely similar. However, no specific leadership competencies have previously been empirically identified, explicated, or prescribed for the GSE initiative. Stiles et al. (2017) interviewed 23 leaders in California and Washington in an effort to define the leadership knowledge and actions required to implement the NGSS. The present study built upon that work with interview data from 15 science ambassadors who have been actively

working for over two years to implement the GSE. The review of literature also included studies related to Common Core Math and Reading Standards (Durand, Lawson, Wilcox, & Schiller, 2016; Reade & Carroll, 2018; Remillard & Reinke, in press) so parallels could be made between the distribution of leadership and support for Common Core implementation and that of the GSAP approach.

Despite a decade of science education reform efforts, such as Benchmarks for Science Literacy (American Association for the Advancement of Science, 1993), the National Science Education Standards (National Research Council, 1996), and the most recent Next Generation Science Standards (National Research Council, 2013), student achievement in science has been less than desired (Davis, 2003) and the goals of inquiry standards have yet to be realized (Marshall, Horton, Igo, & Switzer, 2009). This may be due to the fact that educational policy implementation is an extremely complex phenomenon that is subject to a myriad of forces (Cooper et al., 2004; Honig, 2006; Weatherley & Lipsky, 1977). Malen (1994) underscored the inherent role of politics in the adoption and implementation of educational policy. According to Malen (1994), "Policy implementation is a dynamic political process that affects and reflects the relative power of diverse actors and the institutional and environmental forces that condition the play of power" (p.85). Honig (2006) framed policy implementation as the contextual and relational product of particular policies, people, and places. Standards policies (e.g., reform-based science standards) are no exception, and those that call for more inquiry and student-centered instructional practices pose special challenges for teachers, students, and implementing agents alike (Anderson & Helms, 2001; Spillane & Callahan, 2000; Stiles et. al, 2017).

Schneider and Ingram (1990) described policy tools as instruments through which governments seek to achieve policy purposes; both "standards" and "education" were included

among their list of various tools. More specifically, capacity-building tools are those which provide information, training, education, and resources for enabling individuals, groups, or agencies to contribute to policy goals (Schneider & Ingram, 1990). In this regard, the GSAP and its ambassadors may qualify as capacity-building policy tools. It is a professional network of trained instructional leaders supported by print, digital, and web-based resources, and their mission is to transform science education in the state of Georgia by training and supporting other educators to leverage the new science standards. However, Spillane and Callahan (2000) pointed out that local implementers do not usually encounter reform proposals exclusively through the neat packages assembled by the state policy makers, but rather through a variety of arenas and formats otherwise known as policy environments.

The relative success or failure of any educational policy implementation, including state standards, may depend on the clarity of the policy message, implementing agents' cognition or sensemaking processes (Spillane, Reiser, & Gomez, 2006), the degree of support and reinforcement for implementing the policy (Datnow & Stringfield, 2000; Mac Iver & Farley, 2003), and the agendas and interests of local implementers (Cooper et al., 2004). Teachers are the street-level bureaucrats ultimately responsible for implementing learning standards, and their knowledge, beliefs, experiences, teaching skills, perceptions of the standards, sense of self-efficacy, and personal motivation levels contribute to varying degrees of implementation (Klieger & Yakobovitch, 2011). At the same time, building and district leaders may have conflicting beliefs, values, and intentions related to proposed reforms, which can result in confusion, inconsistent reform efforts, and implementation failure (Foley, 2001). The following sections link GSA's leadership roles and essential responsibilities to current research about systems theory and thinking, distributed instructional leadership, positionality and power, and the

support of policy initiatives. Additionally, the review includes the sub-topics of reform-based science standards, cognitive sensemaking, boundary-spanning, problem-framing, capacity building, and professional development.

Systems theory and thinking for leadership and policy implementation. The research literature highlighted in the following section demonstrates the versatility of systems theory and systems thinking for studying and understanding a variety of phenomena. The review indicates how a systems perspective can be applied to instructional leadership, organizations, policy implementation, the research process in general, and the GSAP investigation specifically. A systems perspective of learning and organizational effectiveness is explained, the need for systems thinking in leadership is argued, six key drivers of systems change are discussed, and the connection between systems thinking and professional development is introduced. Systems thinking is made relevant to various aspects of ambassadors' implementation work, such as a research-based model, which depicts the GSAP's organizational sub-systems.

Systems thinking is viewed by some principals as an enabler of instructional leadership, particularly for improving curriculum, developing professional learning communities, and interpreting performance data (Shaked & Schechter, 2018). Stone and Heen (2014) explained the multiple benefits of using a systems lens for understanding feedback, which is essentially what the participants of the study provided via qualitative interviews. According to Stone and Heen (2014), systems thinking offers a better sense of the whole by accounting for multiple perspectives, correcting for any single perspective, revealing circles and cycles of causality, and clarifying how individuals' interlocking actions, choices, and preferences resulted in particular outcomes. More importantly, a systems approach characterizes problems as multifaceted, which moves the focus away from judgement and towards a sense of appropriate action for problem

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resolution and forward progress (Stone & Heen, 2014). One example of this was a study by Edgerton and Desimone (2018), which examined the links between policy, instruction, challenges, and resources for implementing College and Career Readiness Standards. Edgerton and Desimone (2018) measured how teachers experienced policy in terms of resources, challenges, and professional development, how those policy perceptions related to instruction, and whether the perceptions held constant across rural, suburban, and urban districts. They discovered significant differences in standards-emphasized content between those who teach different subjects (e.g., ELA and Math), educational levels (elementary versus secondary), subgroups (e.g., students with disabilities), and in different settings (rural, suburban, or urban). Those findings highlighted the multi-dimensional systems aspect of standards implementation.

A systems perspective of learning and organizational effectiveness also related to the case study. Andreadis (2009) conceptualized organizations as large processing units that use a series of interdependent and linked work processes to create valuable products or services. According to Andreadis (2009), every organization serves as a host to four interrelated and intersecting subsystems (governance, management, work, people) within which people perform hundreds of simple and complex tasks on a daily basis. Each of the tasks act as a mini-system unto itself, with inputs, outputs, and consequences that affect all other subsystems of the organization. A systems perspective is useful for understanding organizational effectiveness, and it may be necessary for leading organizational change and improvement. Figure 2 shows how a modified version of Andreadis's organizational subsystems model can be applied to the GSAP.
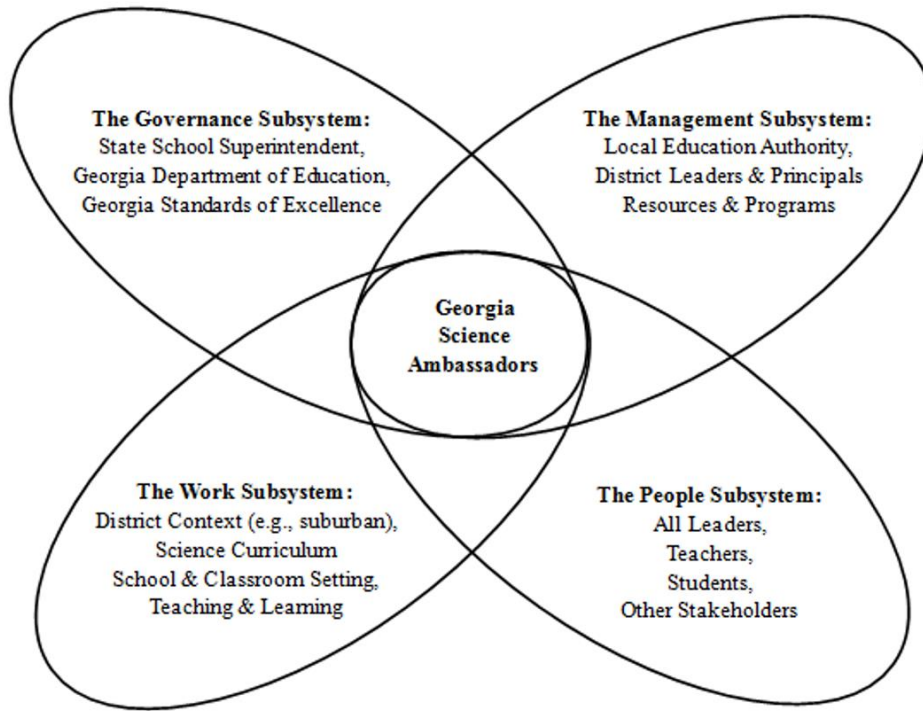
Figure 2. Subsystems of the Georgia Science Ambassador Program.

S*ystems change*, which includes the discipline of systems thinking, is one of six

foundational leadership knowledge areas required to lead the implementation of reform science

standards such as the NGSS and GSE (Stiles et. al, 2017). According to Stiles and her

colleagues, "Leaders at all levels of the system need to know the research on individual,

organizational, and systems change, and develop an understanding of the principles of systems

change and how these principles inform the implementation of the NGSS" (p. 19). As the

elementary science ambassadors and other leaders work to implement the GSE, their critical

actions should be informed by and focused on six system drivers, which Stiles et al. (2017)

proposed will most influence the impact of the standards on classroom practice. Those six

drivers included: (a) standards, (b) curriculum, instruction, and assessment, (c) policies, (d) key

stakeholders, (e) funding, and (f) professional learning. The current study considered and

connected these system drivers within the systems theory framework, and it applied them to the analysis of GSA participants' perceptions and experiences.

A thorough examination of professional learning (PL) as a system driver will follow, but it is worth noting at this point the bridge between professional learning, systems theory, and the implementation work of science ambassadors. Learning is a dynamic process that occurs within a dynamic system; learning outcomes depend on context, time, people, the dynamic interplay between knowledge development and reasoning, and the motivations, beliefs, goals, and values of the people within the system (National Academies of Sciences, Engineering, and Medicine. 2018). Learning Forward's (2017a) *Standards for Professional Learning* have called upon leaders to establish organizational systems and structures to support professional learning. The standards recommend that leaders actively engage policy makers and decision makers to ensure that resources, policies, and other structures are leveraged to support, monitor, and evaluate professional learning (Learning Forward, 2017b). This assumes that leaders such as the GSA comprehend systems theory and systems thinking well enough to recognize and employ their own stature, engage with educational leaders and policy makers, and establish systems and structures to support effective implementation of the GSE for Science. Shaked and Schechter (2016) found that middle leaders, those responsible for implementing decisions and making them a reality, lacked knowledge of systems thinking and its potential impact on their practices.

Distributed instructional leadership. This section provides a synopsis of distributed instructional leadership, a variant of the classic distributed leadership model, and it explains how both relate to organizational improvement and policy implementation. The literature reviewed in the following paragraphs distinguish the subtle differences between distributed leadership and distributed instructional leadership. The discussion includes challenges and questions that

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surround distributed leadership, such as the disconnect between its theory and practice. Connections are made between the research literature on distributed leadership and the mission of science ambassadors.

Distributed leadership is grounded in activity and context as opposed to role and position; leadership functions and activities are stretched over a number of individuals and accomplished through multiple leaders' interactions (Harris, 2007; Spillane et al., 2004). Distributed leadership is primarily concerned with leadership practices (Harris & DeFlaminis, 2016), and it focuses on the interactions of formal and informal leaders (Harris & Spillane, 2008). By comparison, distributed instructional leadership attempts to describe how leaders can create optimal learning environments for students and teachers by drawing on the conceptual tools and techniques of distributed leadership and distributed cognition (Halverson & Clifford, 2013; Spillane et al., 2004).

Research has shown that distributed leadership positively influences organizational outcomes (Lee, Hallinger, & Walker, 2012; Harris & Spillane, 2008). Lee et al. (2012) found that distributed instructional leadership can be used to forge and sustain professional interactions among staff across programs and organizational units. However, a chief concern for leaders is how distributed leadership should be leveraged, and by whom, in order to transform and improve organizations (Harris & Spillane, 2008). According to the Georgia Leadership Institute for School Improvement (2015), principals who wish to distribute leadership effectively must be genuinely inclined to recalibrate their leadership to allow teachers to assume new leadership roles and join in school decision-making. This may require principals to use reflective practices or research-based self-assessments to decipher their own dispositions towards authentic distributed leadership and their readiness to grow new leaders (Georgia Leadership Institute for

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School Improvement, 2015). These findings signify a potential challenge to the GSAP design

and ambassadors' implementation efforts. Principals and district leaders have ultimately decided

whether and how to leverage distributed instructional leadership for rolling out the GSE,

including whether and how to utilize their science ambassadors. However, GSAP programming

did not account for the leaders' inclinations, reflective practices, or their willingness to grow new

leaders.

   Martin, Kragler, and Frazier (2017) asserted that school leadership should take a more

active role in implementing any new policy by carefully reviewing it with teachers, accounting

for teachers' and leaders' beliefs, needs, practices, and assumptions, and working collaboratively

with teachers to develop a plan for implementation. However, even if school leaders opt for a

distributed leadership approach to policy implementation, district leaders may limit decision-

making authority and narrow participation in decision processes (Coburn, Toure, & Yamashita,

2009). Such limiting and narrowing by district leaders is noteworthy because it signifies how

one or more individuals can alter or influence other actors and outcomes within the system

(Andreadis, 2009), including the distribution of leadership and support. Corrigan (2013) also

pointed out differences between the rhetoric and practical application of distributed leadership;

his argument was premised on the inadequate treatment of power in distributed leadership

theory. Corrigan (2013) proposed that our educational system and the teaching profession are

highly regulated by governmental authority, which wields accountability through a hierarchal

power structure, and the appeal and hopeful language of distributed leadership does not change

that reality. Elementary GSA operate within this hierarchy, so the distribution of leadership and

support which they rely on is subject to the power dynamics that Corrigan (2013) described. A

distributed leadership model and systems-perspective of policy implementation accounted for the

dissonance that is sometimes created by different actors' cognition, authority, positionality, and decision-making processes.

   Positionality and power. The research literature examined in this section accounts for power dynamics and the significance of position, authority, and relationships. The selected studies highlight the central role that leaders play in policy implementation, such as problem-framing and limiting participation in decision-making processes. This section also looks at whether teacher and leader roles are complementary, as well as the disparities that exist between leaders' self-perceptions of instructional leadership compared to others' perceptions of them. Attention was given to social network patterns, which included GSA, and the importance of where individuals were located (i.e. central or periphery) within the advice-seeking network of followers. Finally, the concepts of boundary spanning and knowledge brokering were examined. The topics and discussions clarify how elementary science ambassadors have negotiated the power structures and political arenas in which they are situated in order to transmit information about the GSE for science.

   Schools can be thought of as political arenas, with a particular social architecture, which comprises a myriad of formal and informal roles, relationships, and power dynamics (Bolman & Deal, 2013). Policy unfolds through the communications and actions of individuals within these organizational and political arenas, which may be a function of their respective positionality or authority status. Coburn (2006) showed how problem-framing during policy implementation was not only shaped by authority relations, but it also motivated and coordinated action, reshaped authority relations, and influenced teachers' beliefs and practices. However, when disagreements occurred or extended debate did not yield a shared decision, the ultimate solutions were made by individuals with positional authority (Coburn et al., 2009).

In 2017, the Georgia Science Teachers Association (GSTA) and the Georgia Council on Social Studies (GCSS) administered a survey to Georgia teachers and administrators. According to the results, 50% of elementary teachers said that too little time was spent teaching science, whereas only 40% percent of administrators felt that inadequate time was spent on science instruction; administrators and teachers both believed that the amount of science instructional time was primarily determined by principals, followed second by district offices (Georgia Science Teachers Association & Georgia Council of Social Studies, in press). The disconnect between administrators' and teachers' perceptions about the amount of professional learning and support still needed may be a direct result of whether and how leaders have framed the issue of the Georgia Standards of Excellence for Science. The misalignment between elementary school teachers' and administrators' beliefs about the amount of time dedicated to science instruction and the need for supplemental training and support also relates to Coburn et al.'s (2009) findings about positional authority taking precedence. Although teachers and leaders disagree about the adequacy of instructional time allotted to science instruction, both parties agreed that principals usually decided how much time was designated for each subject (Georgia Science Teachers Association & Georgia Council of Social Studies, in press).

Firestone and Martinez (2007) suggested that the capacity to adopt an inquiry-oriented approach to teaching science is a function of instructional and distributed leadership practices. More specifically, they considered the distribution of leadership tasks and activities across roles and whether the work of district leaders and teacher leaders was complementary (Firestone & Martinez, 2007). Blitz and Modeste (2015) examined differences between teachers' and leaders' assessment of distributed leadership practices. The top two sub-domains with the greatest difference between teacher and leader perceptions were formal leaders being recognized as

instructional leaders and socially distributed leadership; the fourth highest was collaborative school-wide focus on teaching and learning, which also focused on teachers' roles in leadership tasks (Blitz & Modeste, 2015). The connection of these findings to the GSAP is that (a) ambassadors may be underutilized simply because the principal views him/herself as being the instructional leader of the school, (b) principals may genuinely believe that they are distributing leadership and support to the GSA when in actuality they are not, and (c) the principal fails to garner collaborative school-wide support for GSE implementation because he/she perceives that it already exists.

Social network analysis research has provided what might be an early indicator that leadership tasks and activities have not been distributed to elementary ambassadors and that elementary-level GSA are not complementing the work of district leaders. Wang and Hendrick (2017) analyzed the social and advice-seeking networks that have facilitated the distribution of information about the Science GSE across the state. The researchers administered a social network analysis survey to 688 Georgia science educators, including 50 science ambassadors, to measure centrality and betweenness. Centrality and betweenness describe the extent to which individuals are integrated in the network, function as a bridge between different subgroups, and influence the flow of information across network paths. According to Wang and Hendrick (2017), the higher the in-degree centrality of an individual, the more influence they may have on the flow of information. An individual's position within an advice network of followers is critical to their leadership (Chiu, Balkundi, & Weinberg, 2016; Oc, 2018). Group members who are more centrally located in the network are more often perceived as competent, socially powerful leaders (Oc, 2018). The analysis by Wang and Hendrick (2017) found that science ambassadors were distributed rather evenly throughout the communication network, as opposed

to being centrally located. Only two GSA were among the top ten individuals with the highest in-degree centrality, but one was a district science leader and the other was a high school teacher with 25 years of experience. Wang and Hendrick (2017) anticipated that as the implementation of the Science GSE continues (a) more teachers and leaders will engage in the standards advice-seeking network, (b) the number of ambassadors in the advice-seeking network will grow, and (c) ambassadors' centrality in the network will increase.

***Knowledge brokers* and *boundary spanners*.** Policy implementation may depend on the extent to which information is mobilized, translated, and transferred across organizational boundaries (Meyer, 2010; Tushman & Scanlan, 1981). Knowledge brokers are people and organizations that translate and mediate knowledge, make it more robust and usable, and transmit it between places (Meyer, 2010). Boundary spanners engage in knowledge brokering by processing, filtering, and transmitting information that connects different constituencies and links organizations to their external environment (Aldrich & Herker, 1977; Wenger, 1998). Individuals in boundary spanning positions use negotiation, persuasion, and their coordinating roles for dovetailing and diplomatic efforts (Bolman & Deal, 2013). Coldren and Spillane (2007) described boundary spanning as having a significant role in instructional leadership practices, particularly as those practices relate to professional resources, development, and the situational context. On policy learning, Leicester (2007) characterized boundary spanning individuals as intrinsically curious and motivated to learn, seeking out knowledge in unrelated disciplines or professional areas in order to make sense of their circumstances. Durand et al. (2016) found that "odds-beating" districts relied on bridging and brokering strategies to successfully implement the CCSS and performed higher than "typical performing" districts on state learning assessments. However, the ability of boundary spanners to effectively obtain,

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import, and disseminate information across boundaries may depend in large part on how others

perceive them in terms of competence, communicative and contextual attunement, and

connectedness (Tushman & Scanlan, 1981). Ultimately, the aptitude of a leader for boundary

spanning, bridging, and knowledge brokering may translate to particular types and levels of

support, both internal and external, for his/her implementation of a given policy.

Support for achieving policy initiatives. The following section includes a review of

literature related to general aspects of leadership and support for policy implementation. The

review begins with a look at what capacity entails (e.g., human, social, financial capital), how it

intersects with leadership dispositions and competencies (e.g., hierarchal position, cognition,

problem-framing), and how leaders leverage their options to manage types and levels of support.

An extensive examination of reform-based science standards with constructivist underpinnings is

provided since the central policy being investigated, the GSE for Science, fits that criteria. The

keystone of the GSAP was professional learning, so research related to professional development

for education reforms are also highlighted.

Policies can be supported or thwarted at various junctures within the system. Leaders'

knowledge, skills, positionality, social capital, and financial resources likely determine how they

interpret policies, frame issues, distribute leadership, and manage types and levels of support.

Notwithstanding the available research on how central offices might support policy initiatives

(Durand et al., 2016; Honig, 2006; Mac Iver & Farley, 2003; Spillane & Callahan, 2000), the

precise role of leadership in policy implementation has not been explicated (Akerson, Cullen, &

Hanson, 2009; Boyle et al., 2013; Davis, 2003; Eisenhart, Finkel, & Marion, 1996). Human

capital, social capital, and financial resources are three highly intertwined factors that help

determine local educational agencies' capacity to support ambitious instructional reforms

(Spillane & Thompson, 1997). Some researchers have argued that educational leaders play a pivotal role in the policy translation and implementation processes by framing policy problems, creating the conditions for policy implementation, building the leadership capacities of others (Coburn, 2005, 2006; Klar, 2012; Spillane & Thompson, 1997), and distributing leadership (Halverson & Clifford, 2013.) The particular way in which a problem or policy is framed may determine measures of preparation, levels of support yielded, and how leadership gets distributed. Cooper et al. (2004) highlighted the critical need to adequately support local decision makers so they will have the capacity to successfully implement proposed reform policies. Building capacity is vital for sustaining implementation of the GSE. Human capital and capacity can be built through communities of practice among teachers and leaders, which are characterized by a network of relationships built out of collaboration, communication, and sharing of knowledge (Stiles et al., 2017).

Durand et al. (2016) underscored the importance of proactive and adaptive leadership skills to implement policy innovations such as the CCSS. Stein and Coburn (2008) showed how districts can support ambitious reform efforts by creating so-called *architectures for learning*, the organizational conditions and systems that lead to significant opportunities for teachers to learn new ideas and practices that align with the reform goals. Indeed, district office leaders oftentimes interpret new standards-policies (Coburn, 2005; Hill, 2006; Honig, 2006; Veal et al., 2016) and attempt to lead reform efforts (Brezicha, Bergmark, & Mitra, 2015; Coburn, 2001, 2005, 2006). One way that central offices support new instructional practices is through professional development for administrators and teachers (McLaughlin & Marsh, 1978). Some studies suggest that professional development may be the key to successful implementation of reform-based science standards (Akerson et al., 2009; Boyle et al., 2013; Davis, 2003; Eisenhart

et al., 1996), and administrators must create a context and conditions that support the professional learning (Brunsell, Kneser, & Niemi, 2014; McLaughlin & Marsh, 1978). However, the precise role of distributed instructional leadership in that process, and for policy implementation in general, has yet to be determined. Since the central policy of the present case was the Georgia Standards of Excellence for Science, a logical sequence of discussion points was reform-based science standards with constructivist underpinnings, followed by cognitive sensemaking, and finally professional learning as a critical support for implementation.

Reform-based science standards with constructivist underpinnings. The Georgia Standards of Excellence (GSE) for Science signified a nationwide trend of re-conceptualizing and improving science instruction. Reform-based state standards such as the GSE for Science signal new directions and approaches in educational policymaking, and they illustrate the manner in which policy makers have attempted to transform and improve science teaching and learning (Spillane et al., 2002). The GSE and other similar standards promote innovative instructional practices that are more constructivist in nature, engaging and appealing for students, and which are expected to produce more STEM field workers (Georgia Department of Education, 2016b; National Research Council, 2012). However, Bianchini and Kelly (2003) pointed out that the United States has a lengthy history of proposed science education reforms, which include *Project 2061: Science for All Americans* (American Association for the Advancement of Science, 1989), the *National Science Education Standards* (National Research Council, 1996), the state of California's (2006) *State Content Standards*, and the *Next Generation Science Standards* (National Research Council, 2013). The GSE for Science may simply be the latest attempt at what Spillane et al. (2002) referred to as unprecedented efforts to reform the quality and content of instruction in America's schools.

The NGSS immediately preceded and inspired the GSE for Science, and they were

intended to be used by states for the same purpose as Common Core State Standards (CCSS) for

Reading and Math – to align curriculum, instruction, assessment, and professional development

(National Research Council, 2013). Similar to the NGSS, the GSE for Science promote a

progressive science curriculum and pedagogical practices for science instruction based on the

most recent and comprehensive research (Georgia Science Teachers Association, 2016). In fact,

the same resource that was used to formulate the NGSS, *A Framework for K-12 Science*

Education (National Research Council, 2012), served as the foundational document for drafting

the GSE for Science (Georgia Department of Education, 2016a). According to this resource, the

overarching goals of K-12 science education are for all students to gain an appreciation for the

beauty and wonder of science, possess sufficient knowledge of science to engage in discussions

and carefully consume scientific and technological information, learn skills that enable career

choice – especially STEM field occupations – and continually learn about science outside of

school (National Research Council, 2012). Learning standards and science instruction that

qualifies more students for STEM field careers is especially important since up to 76% of new

jobs created in the U.S. will require workers that have proficiency in STEM (Georgia Science

Teachers Association, 2016). New science benchmarks and learning standards such as the

NGSS and GSE represent a crucial first step, but the overarching goals cannot be achieved unless

curricula, instruction, professional development, and assessment are also changed to align with

the framework's vision (National Research Council, 2012).

Klieger and Yakobovitch (2011) characterized "standards" in education as the

framework, outline, and uniform criteria used for planning learning and evaluating students'

achievements in terms of their knowledge, values, and skills. Reform-based science standards

such as the NGSS and GSE for Science may be considered policy innovations since they are structured to improve the instructional core (Durand et al., 2016; Elmore, 2004). A major feature of reform-based standards, which may or may not be considered an improvement, is their emphasis on inquiry teaching methods. Innovative science standards prompt teachers to re-think how they teach science by requiring opportunities for students to authentically engage in science practices and experiences (Veal et al., 2016). Such standards are typically constructivist in nature, and they encourage an approach that is grounded in students' prior knowledge of and experience with scientific ideas (Spillane & Callahan, 2000). Multiple research studies have suggested significant benefits of inquiry instruction, including increased student achievement, long-term retention, a narrowing of achievement gaps, and more equitable learning opportunities (Boyle et al., 2013). Wilson, Taylor, Kowalski, and Carlson (2009) showed that traditional instruction created an achievement gap by race, whereas inquiry instruction did not. Similarly, a study by Januszyk, Miller, and Lee (2016) concluded that the NGSS benefited English Language Learners (ELL) in particular because the standards demonstrated a commitment to accessibility of science content by all students, which in turn makes Science, Technology, Engineering, and Mathematics (STEM) fields a more viable option for ELL students.

Although the GSE for Science have not yet been fully implemented or evaluated, there exists a rich and robust body of research literature, which may elucidate and inform the GSAP about distributed instructional leadership (Halverson & Clifford, 2013; Firestone & Martinez, 2007), systems theory (Andreadis, 2009), how to support curriculum changes (Datnow & Stringfield, 2000; Jones, Potter, & Ebrahim, 2001; Mac Iver & Farley, 2003), reform-based standards (Davis, 2003), cognition (Coburn, 2005; Coburn et al., 2009), and policy implementation in general (Datnow & Stringfield, 2000; Durand et al., 2016). Published reports

based on the California NGSS K-8 Early Implementation Initiative Project (Tyler, Britton, Iveland, Valcarcel, & Schneider, 2016) and the recent webcast of a *Workshop on NGSS District Implementation* (National Academies of Sciences, Engineering, and Medicine, 2019) revealed valuable insights and lessons learned, many of which may be transferrable to the GSE Science Initiative in Georgia. Other studies investigated the significance of cognition in interpreting new standards-policies (Hill, 2006; Honig, 2006; Veal et al., 2016), the role of district leadership in the implementation process (Durand et al., 2016; Mac Iver & Farley, 2003; Spillane & Callahan, 2000), and the importance of professional learning for successful implementation of science reforms (Akerson et al., 2009; Boyle et al., 2013; Martin et al., 2017). Publications from the National Science Teachers Association have promoted inquiry-based science education (Bybee, 2013; Schwarz, Passmore, & Reiser, 2016) and provided guidelines for introducing teachers and administrators to the NGSS (Brunsell et al., 2014). Professional resources and qualitative findings about the benefits of reform-based science standards abound (Boyle et al., 2013; Januszyk et al., 2016; Veal et al., 2016). However, they are offset by cogent illustrations of the challenges associated with their implementation (Anderson & Helms, 2001; Spillane & Callahan, 2000).

Change is hard, as Davis (2003) denoted in the title of her study about reform and science teachers' learning of innovative practices. There are special challenges associated with implementing any policy or reform agenda (Anderson & Helms, 2001), and novel learning standards are no different. The implementation of new standards is subject to systemic and dynamic forces. Lipsky (1980) asserted that policy actors at the lowest levels of implementation, for instance classroom teachers, function as street-level bureaucrats who decide if and how policies actually get implemented. In fact, implementation problems may be a product of

implementers ignoring, sabotaging, or adapting the reform policies (e.g., reform-based science standards) to fit their own agendas and preferences (Spillane, 2000). Datnow and Stringfield (2000) noted the important role that context plays in the implementation of any reform. Indeed, Spillane and Callahan (2000) claimed that, when teachers' work environments do not incentivize implementation and fail to provide opportunities to learn about the new standards, effective implementation is unlikely. Unfortunately, implementation is often shaped by ambiguity, uncertainty, and perceived incoherence of professional development focused on new science standards, specifically with regard to instructional goals, accountability measures, and adequate resources (Allen & Penuel, 2015). In studying the implementation of the *National Science Education Standards*, Anderson and Helms (2001) identified the dilemmas that teachers face, which include time constraints, tension between idealized expectations and perceived realities, and countering the deeply ingrained current culture of student roles, work, and equity issues.

Another challenge posed by innovative science standards may be the unfamiliarity of subject matter content (SMK) and pedagogical content knowledge (PCK) embedded within the standards (Marshall et al., 2009). Spillane and Callahan (2000) found that new state standards encouraged a fundamental transformation of the pedagogy and epistemological functions of science education, which involved much more than simply changing the forms of instructional activities. For instance, the GSE for Science require students to use crosscutting concepts to make connections across scientific disciplines. The standards also ask students to emphasize evidence and use scientific principles, models, and theories when they construct scientific explanations. These expectations demand new and different pedagogical approaches on the part of the teacher as well as fundamentally different learning outcomes for students. The goal of inquiry and reform-based science standards is for students to be doing science instead of learning

about it (Moulding, Bybee, & Paulson, 2015). This requires that teachers (a) recognize the importance of curiosity for teaching and learning, (b) be able to sustain and build students' curiosity into genuine interest in scientific phenomena, and (c) understand ways to utilize that curiosity and interest for effective science instruction (Moulding et al., 2015).

Finally, reform-based standards may be perceived as an asset or a detriment by teachers at the classroom level, but that outcome may reflect the level of implementation support provided by building leaders or district central offices (Datnow & Stringfield, 2000; Durand et al., 2016). According to Durand et al. (2016), the main challenges of policy innovations are leaders' preparation, readiness, and competency for adopting and implementing the policy; making sense of the policy and its requirements; developing contingencies for local implementation; and understanding how the policy's features might facilitate, constrain, or impede implementation. Harvey (2017) reported that middle and high school principals were not perceived as a knowledgeable source of support for implementing the GSE for Science, and they offered little or no assistance with improving teachers' instructional practices. Research clearly indicates the challenges and benefits associated with reform-based science standards, but much research is still needed (Anderson & Helms, 2001).

Cognitive perspective. Policy implementation necessarily involves a process of interpretation and adaptation, whereby meaning is constructed (Anderson & Helms, 2001; Datnow & Stringfield, 2000; Spillane, 1998; Spillane & Callahan, 2000). Interpreting new educational standards involves teachers constructing ideas about instruction, and that is influenced by their personal beliefs, values, knowledge, dispositions, the policy itself, and the context of their sensemaking (Spillane, 1998). There are cognitive, historical, cultural, normative, social, and political aspects of the negotiating and sensemaking dimension of

learning, and these also determine how central office administrators participate in teaching and learning improvement efforts (Honig, 2008). It is no surprise then that local policymakers develop divergent understandings of the standards they are charged with implementing.

Ambassadors' perceptions about distributed leadership and support for implementing the GSE may have largely depended on their interpretations of the new standards and their ambassador roles and responsibilities. Research has shown that successful implementation of any policy hinges on implementing agents' cognition about the policy initiative and implementation process, which includes perceptions and interpretations based on past experience and knowledge (Honig, 2006; Spillane & Callahan, 2000, Spillane et al., 2006). Interestingly, the vast majority of Georgia Science Ambassadors are predominantly classroom teachers with minimal training on constructivist-based science education and little or no knowledge of policy processes. The teaching experience of ambassadors ranged widely, but it may be worth noting that some were initiated into the group having less than five years of service in the field of science education. The teaching tenure of Georgia Science Ambassadors, combined with their diverse levels of familiarity with policy and constructivist-based science, may contribute to how they have perceived and experienced their GSAP policy work.

Policy implementation is shaped by individuals' knowledge and experiences, social context, formal and informal organizational structures, professional affiliations, social networks and interactions, organizational histories and traditions, and constraints (Spillane et al., 2006). Coburn and colleagues (Coburn et al., 2009) argued that decision-making processes, including the use of evidence, are centrally about interpretation, argumentation, and persuasion. An "interpretive space" always exists between the definition of a problem and proposed solutions; as decision makers operate within that space, interpretive processes, competing agendas, and prior

working knowledge determine how they move from information to appropriate action (Coburn et al., 2009). The term "decision makers" in this sense can include science ambassadors as well as building, district, and other leaders.

Spillane and Callahan (2000) attributed implementation failure to local implementers' misconstruing the intent of science reform policy proposals. Similarly, Coburn (2001) found that educational policy enactment hinges on teachers' interpretation and discretion. If practitioners perceived the changes called for in the new standards as dramatic and difficult to put into practice, their implementation results were generally unsuccessful (Anderson & Helms, 2001). Spillane et al. (2006) observed that, in cases where the implementation of policies pressed for complex changes in extant behavior, implementing agents were oftentimes novices that drew surface-level connections between new policy ideas and prior experiences, which resulted in a conserving nature of teachers' sensemaking of new state standards. When new standards-based instructional approaches require fundamental shifts in how individuals view their practices and a restructuring of a complex set of existing mental schemas, "the new ideas may be perceived as minor variations of what is already understood rather than as different in critically important ways" (Spillane et al., 2006, p.51). A major goal of current science educational reforms is for students to use the scientific and engineering practices to make sense of the natural and designed world, but since this seems like nothing new to many educators, their students remain passive recipients of knowledge by studying and recounting factual information and definitions (Schwarz et al., 2016).

Language plays a pivotal role in how reform policies are interpreted and implemented. Hill (2006) noted that language is a key medium for the construction and expression of policy, and linguistics can be useful for understanding how language and discourse shape policy

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implementation. According to Spillane and Callahan (2000), language is an integral component

of implementation because it is the main tool used to translate the policy message into practice.

Durand et al. (2016) discovered that Common Core State Standards were implemented more

successfully when leaders developed, stewarded, and emphasized the importance of a shared

vocabulary and language. As Hill (2006) explained, the words and phrases on which a policy

relies can complicate the communication and implementation of the policy. This suggests that

the wording of the Georgia Standards of Excellence (GSE) for Science, as well as the existence

or absence of a shared language amongst GSAs, may affect how ambassadors interpret the

standards policy and engage in the implementation process.

Cognitive and sense-making processes related to new standards policies are by no means

restricted to teachers. Leaders translate policy messages based on their own knowledge and

experience. In consequence, they directly and indirectly mediate teachers' sensemaking by

creating the conditions under which teachers interact with the policy, which inevitably influences

how the policy is interpreted, adapted, and enacted (Coburn, 2005). Brezicha et al. (2015)

advocated for a differentiated leadership approach to reform implementation that considers

teachers' sensemaking processes; they recommended horizontal support structures, flexibility of

reform, a philosophical alignment between leaders and teachers about the purpose of the reform,

and a consideration of empathy, flexibility, and strength of peer networks. These processes,

structures, and considerations may well determine the extent to which the reform effort is

supported. Professional development that includes both teachers and leaders may help to

advance those critical concepts, processes, and structures.

Professional development. Learning is situated and must be understood as an

unpredictable phenomenon, a function of dynamic processes that are dependent on people, time,

and context (National Academies of Sciences, Engineering, and Medicine, 2018). Georgia Science Ambassadors received four days of professional learning as part of the GSAP induction process. The initial two days of training occurred in the summer of 2016, and a second two-day follow-up session took place in the fall of 2016. In addition to the pair of on-site trainings, ambassadors were encouraged to engage in a professional learning community and asynchronous collaborations using an online platform known as EdWeb. It was also anticipated that GSA would design and conduct professional development for the GSE in their respective schools, districts, and in some cases other systems besides their own. Ambassadors' perceptions about their professional development experiences and the online learning community will be elaborated in Chapter 2, but the following review of professional learning literature provides a backdrop for understanding those findings.

Professional learning is arguably an essential means to change teachers' beliefs about inquiry instruction and move them towards inquiry practices (Capps & Crawford, 2013; Kazempour, 2009; Lotter, Rushton, & Singer, 2013), but the research on professional development organized around reform-based standards has shown mixed results (Johnson, Severance, Penuel, & Leary, 2016; Karaman, 2016; Luft, 2001; Spillane & Thompson, 1997). Several studies demonstrated the importance of professional learning for successful implementation of inquiry science (Akerson et al., 2009; Akerson, Hanson, & Cullen, 2007; Martin et al., 2017). Stiles et al. (2017) claimed that it is imperative for all teachers and leaders to have equitable opportunities to engage in high quality professional learning that deepens their knowledge and builds their capacity for implementing reform-based standards. This may be a challenge considering the intrinsic differences between training for teachers and that of leaders. Professional development for principals tends to be advisory as opposed to focused on

instructional leadership, and the prevailing training models are inadequate for contemporary educational reforms that target standards, curriculum, and pedagogy (Little, 1993; Mac Iver & Farley, 2003). Killion and Hirsh (2012) highlighted the inadequacy of traditional professional development models:

> The urgency is high for implementation of the new standards, yet resorting to comfortable and familiar approaches to professional learning such as short-term awareness building information sessions on what the new standards are and how they compare to previous ones will fall short of the intense, practical, content-focused professional learning needed to realize the promise of all students college-and career-ready at the end of high school. (p.6)

Spillane and Thompson (1997) noted the variability and unevenness of instructional reform progress, which they attributed to district leadership's capacity for learning. District leaders' ability to learn new ideas from external policy and professional sources, and then teach the reform ideas to other educators within their district, was quite uneven (Spillane & Thompson, 1997). In fact, leaders differed in how they interpreted, anticipated, and framed problems or changes that necessitated professional learning, which ultimately determined how decision processes played out (Coburn et al., 2009; Durand et al., 2016). Coburn et al. (2009) described one case where a hired consultant decided to emphasize the need for professional development to be situated at school sites because that is where individuals actually grapple with issues, questions, and curriculum. Within a year, the district personnel adopted the belief that high-quality professional learning should be situated at school sites, and they reconfigured their school calendar and professional development plan based on that single criterion. This example demonstrated the fluctuation of instructional reform progress reported by Spillane and Thompson

(1997). Blitz and Modeste (2015) found that leaders rated their instructional leadership roles, including their participation in professional development, much higher than their teachers rated them. The differences were attributed to inflated ratings on part of the leaders (Blitz & Modeste, 2015).

Educational researchers have studied professional development organized around changing teachers' inquiry practices and beliefs in response to the National Science Education Standards (National Research Council, 1996), Common Core, and other reform-based standards (Johnson et al., 2016; Karaman, 2016; Luft, 2001). Johnson et al. (2016) proposed that professional development programs can help teachers to develop common understandings of new academic standards, which can significantly shape how the standards are implemented. Akerson et al. (2007) showed how professional development programs can be structured to help teachers translate the Nature of Science and inquiry strategies into classroom practices. Professional development that allows teachers to reflect on their beliefs and understandings about learning, teaching, students, and science content can facilitate the social construction of new knowledge, provide educators with a bridge to new understandings, and result in changed teaching practices (Akerson et al., 2009; Davis, 2003).

Despite some positive strides, national consensus of policy makers and educators acknowledges a tremendous need for professional learning focused on the requirements of new content standards, reform curricula, and innovative teaching practices (Killion & Hirsch, 2013). Luft (2001) also cited the need for professional development programs that support the vision of science education reform and assist science teachers with actualizing that goal. Strikingly, a national survey found that 15% of K-5 science teachers reported never having participated in science-focused professional development, and an additional 26% had not received science-

focused professional learning in more than four years; approximately 65% of all K-5 science teachers have received less than six hours of science professional learning in the last three years (Trygstad, 2013). In 2017, the Georgia Science Teachers Association (GSTA) and the Georgia Council on Social Studies (GCSS) administered a survey to Georgia teachers and administrators. According to the results of the survey, half of all administrators indicated that their teachers have received the professional learning and support needed to implement the Science GSE; that figure might not seem surprising except that 57% of teachers felt confident to implement the standards, 11% of them felt very confident, and only 28% of teachers indicated a need for additional training and support (Georgia Science Teachers Association and Georgia Council of Social Studies, in press).

Conclusion. The preceding literature review highlighted the extant literature, including strengths and shortcomings, about three key components of the research questions (i.e. distributed leadership, support for policy initiatives, and reform-based learning standards). The review also explored relevant themes related to elementary science ambassadors' work, including positionality and power, boundary spanning, and cognition. A thorough review of research literature justified the interpretive framework for the study, which was a unique combination of systems theory and distributed instructional leadership theory. Educational and policy research has given us a much clearer understanding of the importance of leadership and support for any implementation or change processes, but gaps and disparities still persist. Most studies have focused solely on distributed leadership, instructional leadership, or policy implementation, but few have given attention to the use of distributed instructional leadership for achieving a policy initiative. The current study addressed a gap in the literature by exploring the GSAP's novel use of a distributed instructional leadership model for implementing new science

education standards, namely the Georgia Standards of Excellence for Science. The GSAP case study also demonstrated the usefulness of systems theory and systems thinking to differentiate, bridge, synthesize, and analyze multiple dimensions and phenomena within a study (e.g., people, processes, attitude and beliefs, various forms of capital, etc.), to include the research process itself (e.g., researcher, context, temporality, etc.)

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CHAPTER 2

PERCEPTIONS AND EXPERIENCES OF ELEMENTARY GEORGIA SCIENCE AMBASSADORS ABOUT LEADERSHIP AND SUPPORT

"Nothing is more common than unfulfilled potential" – Howard G. Hendrick

Purpose of the Study

The aim of this study was to characterize the Georgia Science Ambassadors Program (GSAP) by examining the perceptions and experiences of elementary-level Georgia Science Ambassadors (GSA). The goal of the research was to generate an accurate qualitative account of how ambassadors have perceived the distribution of leadership and support for implementing the new Georgia Standards of Excellence for Science (GSE). Identifying and describing how specific leadership practices and types of support have influenced ambassadors' implementation work in elementary schools may create awareness and spark discourse about the program and variations in the GSE implementation. A secondary goal of the research was to inform state policymakers, district leaders, and the GSA about the overall functionality, fidelity, and integrity of the GSAP for successfully implementing the new K-5 science standards. The study was guided by the following two research questions:

1. What are the perceptions and experiences of Georgia Science Ambassadors about the distribution of leadership and support and how it has influenced their ability to lead the implementation of the Georgia Standards of Excellence (GSE) for Science?

2. How do Georgia Science Ambassadors describe the levels and types of support they have received for implementing the new Georgia Standards of Excellence (GSE) for Science?

The research questions were intentionally crafted to solicit a better understanding about the global nature (Yin, 2014), complexity, and uniqueness of the GSAP. The questions elicited how distributed instructional leadership and support of ambassadors have materialized within diverse political, social, historical, and personal contexts (Denzin & Lincoln, 1998; Stake, 1995). Both research questions were also devised with an acute appreciation for the informants through whom the case could be known, including their unique qualities and character, activities and interactions within dynamic systems, and the milieu within which they were embedded (Denzin & Lincoln, 1998).

Statement of the Problem

The GSAP was a novel approach to implementing the Georgia Standards of Excellence (GSE) for Science. Georgia Science Ambassadors (GSA) were directed to work under the auspices of their district and regional leaders to roll out the inquiry-based science standards (Georgia Department of Education, 2016b) and essentially re-brand K-12 science education in the state of Georgia. The conceptual shifts reflected in reform standards such as the GSE and Next Generation Science Standards (National Research Council (2012) have required science teachers to overhaul their curriculum, instruction, and assessment practices (Stiles, Mundry, & DiRanna, 2017). Changes such as these demand that science ambassadors and their leaders provide ample and sustained support and leadership, address and overcome significant challenges, and create a policy environment that is fertile for the reform-based standards to take hold (Stiles et al., 2017).

As the GSA have worked individually and collectively to transform the pedagogy of science education, they have assumed the dual roles of instructional leader and policy implementing agent. However, policy implementation and leadership outcomes are intricately

complex phenomena, products of fluid and dynamic processes influenced by an array of

contextual factors and contingencies (Oc, 2018). Weatherley and Lipsky (1977) described

individuals at the lower-level context of policy making as street-level bureaucrats, policymakers

with substantial discretion in their own respective work areas. The GSAP was intended to

empower and entrust its science ambassadors as street-level bureaucrats and instructional

leaders, embedded within their school districts, to train and equip teachers and administrators for

GSE implementation. However, the programming did not account for individual ambassador's

will and capacity (McLaughlin, 2006; Odden, 1991), such as their ability to interpret and make

sense of the new GSE for Science, their readiness to design and conduct professional

development targeting the new standards, the influence and authority associated with their

current roles, or the types and levels of support received.

Significance of the Study

The GSAP case study was unique in that it gave a direct voice and authentic audience to

15 elementary school teacher-leaders who might otherwise have continued an indefinite silent

struggle. The GSA participants were chosen by their districts and trained by the state, and their

perceptions and experiences were based on two and a half years in the field as science

ambassadors. Honig (2006) suggested that educational policy researchers and practitioners may

help improve the quality of educational policy implementation by discovering what actually

works, the specific context in which it works, and the reasons why it works. The GSAP case

study responded to that critical need by providing the educational community with a sound basis

for leadership practices and supports that promote science education reform (Anderson & Helms,

2001), including professional development for implementing new science standards (Klieger &

Yakobovitch, 2011). This empirical inquiry of the GSAP represented an important first step in

an explorative process that has potential benefits for educational, policy, and research communities. The characterization of the GSAP created awareness and will ideally spark discourse about the special challenges and impediments that were found to exist within the GSAP, the overall functionality and integrity of the program, and how to improve the GSAP. The findings could potentially benefit practitioners, policy makers, and researchers (Briggs, Coleman, & Morrison, 2012) by helping them to make sense of current policy initiatives, determine how best to support ongoing implementation efforts, and plan future courses of policy action. The GADOE claimed that it is using a data-informed continuous improvement cycle to measure and improve the Science Ambassador Professional Learning initiative (Georgia Department of Education, 2018). Now 15 voices from the field have shared their thoughts, feelings, stories, and ideas. Insights gleaned from the empirical qualitative data may contribute to the GADOE's continuous improvement cycle, which could ultimately support the GSA, elevate the existing program, and influence future policy endeavors.

The GSAP case study bridged existing gaps in the literature and extended the current understanding of how the relative distribution of instructional leadership and support either helps or hinders policy implementation. The study built upon the recent work of Stiles et al. (2017) by offering specific guidance to school leaders about how to drive the transformations called for by reform-based science standards like the GSE and NGSS. Stiles and colleagues (2017) outlined what leaders must know and do to effectively lead the Next Generation Science Standards (National Research Council, 2013). The GSAP case study offered a powerful addendum to that work by revealing the status quo of GSE implementation, whether and how leadership and support are actually being distributed, and the challenges that leaders and ambassadors must overcome to effectively lead the GSE. The present study also built on the research of Wang and

Hendrick (2017) by providing a rationale for why ambassadors are not well connected and centrally located in the advice-seeking network. Science ambassadors were distributed rather evenly throughout the network, and there were no elementary GSA among the top ten individuals with the highest in-degree centrality (Wang & Hendrick, 2017). The fact that ambassadors were not more centralized in the network and did not have a higher degree of betweenness may have resulted from state, district, and building leaders not recognizing or emphasizing the significance of the GSA or their roles. Finally, the application of systems theory was significant for contemporary implementation literature. The character and consequences of policies are directly and indirectly shaped by the multiple system levels (e.g., national, state, regional, local) through which they pass, yet few researchers have focused on these inter-level relationships and how decisions at one level influence those at another (McLaughlin, 2006). In addition to bolstering the relevant body of literature, the GSAP case study provided a research-grounded basis for future, comparable, empirical research and analyses. Recommendations for future research are provided in the discussion section.

Methodology

Research design. I utilized a qualitative case study methodology to elucidate the GSAP. True to the description of qualitative research proffered by Creswell and Poth (2018), the GSAP needed to be explored in order to gain a complex, detailed understanding of the program. A qualitative design was deemed optimal because of its propensity for yielding rich and detailed data that could be used to generate a better understanding of the phenomena under study (Bowen, 2005). The phenomena under study were the GSAP as an organizational entity and the perceptions and experiences of its elementary-level GSA about distributed instructional leadership and support.

The practicability for utilizing a case study approach to investigate the GSAP was

determined based on the nature and characteristics of the proposed study (Lincoln & Guba, 1985;

Smith, 1978; Stake, 1995; Yin, 2003). Case studies are deemed most appropriate for intense

empirical inquiry that analyzes the particularity and complexity of a contemporary program

within an authentic and important context (Stake, 1995; Yin, 2003). The GSAP's defined and

confined scope, geographic boundaries, and temporal limitations qualified it as a purposive and

integrated system (Stake, 1995) that met the specificity of boundedness necessary to be

considered a "case" (Smith, 1978). A case is *bounded* when it can be separated out for research

in terms of space, time, or some physical boundaries (Briggs et al., 2012; Creswell, 2012). The

GSAP is a unique club with specific membership criteria, its group members have remained

stable over time, and it is specific to the state of Georgia and the GSE for Science. Furthermore,

the investigation fit the definition of an exploratory-descriptive case study (Yin, 2003) or

intrinsic study (Stake, 1995) because it sought to illuminate a novel and heretofore unexplored

entity based on the need to learn more about that particular case (Denzin & Lincoln, 1998).

Intrinsic cases are unusual, interesting, and have merit in and of themselves (Creswell, 2012).

The pluralistic nature of the GSAP as an educational policy, reform, and leadership program is

one of several interesting aspects of the case.

I recognized that GSA work, from initial training and beyond, was inherently

interpretative. The apparent interpretivist nature of the GSAP work was my principal curiosity

and an impetus for the case study. I also concurred with Denzin and Lincoln's (1998)

assessment that all research is interpretive because researchers are guided by their own set of

beliefs and values about the world and how it should be understood and studied. Therefore, the

exploration of the GSAP, from data collection and analysis to representation and reporting,

assumed an interpretivist-constructivist paradigm (Guba & Lincoln, 1994; Denzin & Lincoln, 1998). My preference for using an interpretivist-constructivist stance was significant because it accounted for my reliance on my own interpretation of observed and recorded data such as events, situations, and the actions or interactions of various actors (Denzin & Lincoln, 1998). It also supported the utility of a "cognitive perspective" as an embedded conceptual lens to guide my actions. According to Spillane, Reiser, and Gomez (2006),

> An individual's prior knowledge and experience, including tacitly held expectations and beliefs about how the world works, serve as a lens influencing what the individual notices in the environment and how the stimuli that are noticed are processed, encoded, organized, and subsequently interpreted. (p.49)

Spillane's (2006) conceptualization of cognition or sensemaking was fitting because it described and encompassed me and my GSA research informants. The cognitive perspective promoted continuity and interconnectedness in the research design and process (Mitra, 2010) by conveniently aligning the purpose of the study, research questions, and the overarching theoretical framework.

Finally, the focus of the study was limited to the elementary level for two important reasons. First, my particular expertise and interests happened to reside at the elementary level when the study commenced. Yin (2014) pointed out that good formal preparation for collecting case study evidence begins with the investigator having the desired skills, values, and training for a specific case study. Even in an exploratory mode, the researcher should have a firm grasp of the theoretical and policy issues being studied so they will be able to interpret information and make analytic judgements throughout the data collection phase (Yin, 2014). The initial GSAP training was partially differentiated for elementary and secondary science educators, and I was

trained specifically as an elementary-level GSA. I was an elementary classroom teacher during the GSAP induction and training, and a full-time Elementary Science Instructional Coach when I conducted the study. Both my formal training and background experience favored a research aim and scope targeted at the elementary-level.

A second consideration for restricting the research to the primary and intermediate grades (K-5) was that elementary-level ambassadors' work was inherently different than their middle and high school counterparts. There are distinct differences between elementary and secondary schools in terms of curriculum factors, instructional delivery, and their organizational, classroom, and leadership structures (Strohl, Schmertzing, & Schmertzing, 2014). Most elementary teachers must teach as generalists, across all content areas, to one group of students in a self-contained classroom format. In contrast, secondary teachers are typically specialists who concentrate on one or two specific content areas such as science or math, to the exclusion of others, in a departmentalized classroom format. Accordingly, each of the two-day GSAP trainings included a general session for all ambassadors, which was followed by breakout sessions that segregated elementary from secondary teachers.

Leadership structures in elementary schools usually include one teacher-leader per grade level who provides general guidance and support to their team members and acts as a liaison between the building administrators and teachers. On the other hand, leadership structures in secondary schools rely heavily on department chairpersons, not only as liaisons but also for distributed instructional leadership (Halverson & Clifford, 2013; Peacock, 2014). Gedik and Bellibas (2015) compared elementary and secondary schools' capacity for distributed instructional leadership, and they found little difference in terms of leadership practices for monitoring teaching and learning. However, the sharp differences in the context and nature of

elementary and secondary teachers' work would have likely led to inconsistent data across their respective levels (e.g., elementary, middle, high). Therefore, the research focused solely on elementary-level ambassadors and their implementation of the K-5 Science GSE.

Conceptual framework. The study was guided by the theoretical perspectives of distributed instructional leadership and systems theory. This dual conceptual frame contained themes that aligned with the research questions and related to ambassadors' work, including formal and informal leadership, district support, positionality and power, and cognition. Ambassadors' implementation work has unfolded within and across complex, multi-layered, integrated systems that enmesh organizations, policies, people, and constructs. Biggs (1993) presented a systems model of teaching and learning that framed education as a set of interacting ecosystems, and he likened the system to a swamp that innovators (i.e., policy agents) must painfully wade through. Biggs noted:

> In the ecology of a system, a change to any one component will, depending on the state of equilibrium already achieved, either effect change throughout and thereby create a new equilibrium and hence a new system, or the changed component will be absorbed, the system reverting to the status quo. (p.76)

In order to drive systems-change that effectively alters teachers' behavior, leaders should be able to recognize the underlying structures, patterns, and assumptions operating within their organizations, and they must be aware of interacting and interconnected systems (Stiles et. al, 2017). One of the leader reflection questions presented in the *Framework for Leading the NGSS* (Stiles et al., 2017) asks, "How did the research on systems change inform your work?" (p.19). It stands to reason that, if educational leaders are not versed in systems theory, their own attempts to implement policies may be misguided at best.

Systems theory and thinking was especially useful as a theoretical framework because it contextualized ambassadors' implementation efforts and experiences within the existing educational system. Furthermore, it accounted for the complexity of the scientific research process, including my actions and reflections (Alhadeff-Jones, 2013). Alhadeff-Jones (2013) showed how systems theory could be used to craft a critical process of research for elaborating the fabric of a phenomenon. As I attempted to unravel the fabric of the GSAP, I conceived the research process as "a system made of sub-systems (author, system of ideas, object of study, and method) characterized by their finalities and their environments" (Alhadeff-Jones, 2013, p.24). I considered the systems aspects of distributed instructional leadership and support while analyzing ambassadors' experiences and perceptions.

Ethical considerations. Ethical consideration permeated every stage and aspect of the research, and special attention was given to ethical dilemmas that are endemic to the data collection phase (Creswell & Poth, 2018). The study was conducted within an ethic of respect for persons, truth, and democratic values (Briggs et al., 2012), and I strictly adhered to established ethical codes and guidelines for gaining informed consent, avoiding inadvertent deception of participants, maintaining their privacy and confidentiality, and ensuring the accuracy of data (Denzin & Lincoln, 2005). Pseudonyms were used for all study participants to ensure their anonymity. I understood that the principle of beneficence extends to third-parties and that I had a duty and obligation to minimize all risks to those individuals, organizations, and institutions (Resnik & Sharp, 2006). Although the study posed no more than minimal risk to subjects or third parties, I consistently sought to identify any and all third parties that might have been inadvertently affected by the research, and the same protocols and protections that were used for research participants were also used to handle and protect third-party data. Naturalistic

techniques were used to collect data in a manner that was sensitive to the sites and individuals involved, and all data was collected and maintained in a secure manner (Creswell, 2012; Creswell & Poth, 2018). I offered to meet each participant on their terms, at a public location, date, and time that was most agreeable with their current schedule and routines. Prior to each interview, I framed it as an open conversation between two fellow ambassadors in which there were no wrong or right answers. I provided a printed copy of the informed consent form to the participant, offering to review the information and answer any questions they had.

      Data collection. Semi-structured interviews with GSA informants were the primary data source used to answer the research questions. The interview data represented multiple realities and perspectives (Creswell & Poth, 2018) from a variety of organizational contexts. The interview sessions were guided by a research-based protocol that was designed specifically for the case study. The interview protocol (see Appendix D) was developed and tested using the interview protocol refinement (IPR) framework, a four phase process designed to strengthen the reliability of the instrument and improve the quality of data obtained from research interviews (Castillo-Montoya, 2016). An important phase of the refinement process was piloting the protocol and its individual questions prior to their use (Castillo-Montoya, 2016; Creswell, 2012; Stake, 1995). I administered the interview protocol to individuals who mirrored the sample population of the study, two fellow elementary science ambassadors whom I knew personally. By piloting the instrument, I gained a realistic sense of the interview process, its duration, and whether interviewees would indeed be able to answer the questions (Castillo-Montoya, 2016). The protocol was revised based on the results of piloting and simulations, and a finalized version was submitted to Georgia State University's Institutional Review Board for approval prior to the study being launched. I structured and conducted the interviews based on guidelines and

recommendations set forth by Rubin and Rubin (2012), Jacob and Furgerson (2012), and Denzin and Lincoln (2005). All interviews were conducted at public locations and times selected in advance by the participants, and each one was audio-recorded to allow for accurate data collection, transcription, and a detailed analysis of the content (Rubin & Rubin, 2012). The mean duration for the face-to-face interviews was 40 minutes.

In addition to the interview data, I contributed a detailed account of my own personal experiences and perceptions as an elementary GSA (see Appendix L). My input was critical for demonstrating reflexivity and transparency because it recognized and addressed the fact that a researcher's position and perspective invariably shape his/her research (Malterud, 2001; Merriam, 2009). According to Malterud (2001), "A researcher's background and position will affect what they choose to investigate, the angle of investigation, the methods judged most adequate for this purpose, the findings considered most appropriate, and the framing and communication of conclusions" (pp. 483-484). My personal account was included as an additional data point that helped contextualize the findings, but it was not incorporated into the interview data. On several occasions and across multiple interviews, participants inquired about how my personal experiences compared or contrasted with their own perceptions and experiences. In these instances, my background experiences were important because they helped establish credibility and rapport with the study participants.

Archival documents, digital sources, audio-visual artifacts, and my memos were also collected and used for multidimensional analysis and data triangulation. Archival documents included official publications from the GADOE and other organizations about the GSAP, ambassadors' training itineraries and handouts, a published version of the new GSE for Science, a "standards crosswalk" document that compared the former Georgia Performance Standards to

the new science standards, email correspondence from the GADOE to the cohort of ambassadors, and books pertaining to reform-based science initiatives. Digital and audio-visual sources included GSAP training presentations and videos, documentary-style recordings of the GSAP training sessions, a recorded workshop on NGSS district implementation, and relevant websites or web resources related to the GSAP (e.g., Georgia Department of Education website, Georgia Science Teachers Association site, Georgia Science Ambassadors site, recorded webinars, etc.).

Data obtained from secondary sources were triangulated with GSA interviews, which enhanced the richness and integrity of the study. I scrutinized the content of documents and artifacts to discern how it compared, contrasted, or aligned with the data obtained from interviews. I inspected for evidence of emergent patterns and themes that related to the study's research questions and theoretical framework, all the while remembering that the content was written or developed for a specific purpose and audience other than those of the case study (Yin, 2014).

Participants. The core constituency of the GSAP was originally 299 Georgia Science Ambassadors, which included public and charter school teachers and administrators, central office personnel, four professors of higher education, three teachers from the Department of Juvenile Justice, and directors from seven Georgia Youth Science and Technology Centers (GYSTC). These individuals represented diverse personalities, positions, and power based within the network of ambassadors and the larger educational system. Ambassadors were distributed proportionally throughout each of 16 Regional Education Service Agencies (RESA) that geographically cover the entire state of Georgia (see Appendix C). Contact information for 299 of the ambassadors was publicized in a document that was drafted and strategically

disseminated by the GADOE. There were 74 elementary-level ambassadors representing 25% of all GSA, and each RESA contained at least one elementary GSA. I utilized a combination of purposive sampling strategies to recruit 15 of those ambassadors for the study.

A purposeful, theory-based, criterion sampling strategy was used to select elementary GSA informants from separate Georgia school districts. Theory-based sampling, also known as concept sampling, selects individuals who could potentially help the researcher discover or better understand specific concepts within a particular theory (Creswell, 2012). The objective of theory-based sampling is to find, elaborate, and examine the manifestations of certain constructs and their variations (Palinkas et al., 2015). In this case, I was interested in how distributed instructional leadership and systems theory related to elementary-level ambassadors' implementation efforts. For instance, science professional learning is by no means exclusive to the recently commissioned science ambassadors, and distributed leadership is not typically a key feature of professional development. However, the GSA would be able to offer firsthand accounts about the extent to which their leaders allowed or empowered them to design, plan, and implement professional learning for GSE Science implementation. The choice of elementary ambassadors also isolated the construct of distributed instructional leadership to one discrete level of the system, which was primary and intermediate (K-5) grade levels.

Criterion sampling, which selects individuals who meet some predetermined criterion of importance (Palinkas et al., 2015), also guided the overall sampling strategy. The criterion for participating in the present study was one or more consecutive years of experience as an elementary-level GSA. This criterion was important because it ensured that study participants had sufficient and relevant experience on which their perception data was based. For example, one respondent was excluded from the study because she transitioned from elementary school to

a middle school position immediately after her GSA training. However, the sample included two

middle school teachers who served for two years as elementary-level ambassadors but recently

assumed middle school roles.

An invitation to participate in the study (see Appendix E) was shared via email with all

74 elementary science ambassadors. The invitational email script included a link to an online

questionnaire (see Appendix F), which allowed individual ambassadors to opt into the study,

acknowledge their informed consent, and provide demographic data about themselves and their

respective districts. Ultimately 15 elementary GSA self-selected to participate in the study.

Each of the 15 volunteers were from different public school systems that were located within 11

of the 16 regional areas (RESA), so there was no need to limit candidacy based on district

affiliation. By recruiting ambassadors from different school systems and multiple geographic

regions, I hoped to represent multiple realities, diverse perspectives, and a variety of

organizational contexts from across the entire state. The demographic portion of the online

questionnaire was used to collect information about each participant, including age, ethnicity,

teaching tenure, grade-levels taught, and whether their district was located in a predominantly

rural, urban, or suburban setting. I also collected publicly available data to learn the number of

students served in each participant's district. A summary of the questionnaire results can be

found in the *data collection* section that follows and Appendix G. It was important to illustrate

the composition of the research sample, which reflects the diversity of people, professional

backgrounds, perspectives, and contexts represented in the research findings.

A sample of 15 ambassadors was considerate of resource and time limitations (Creswell

& Poth, 2018) but large enough to assure that most or all perceptions that might be salient or

consequential were uncovered (Mason, 2010). Hagaman and Wutich (2017) found that 12 to 16

interviews were sufficient to capture the views of a relatively homogeneous population on focused topics. The results of their theme analyses indicated that, "as Guest et al. (2006) and Francis et al. (2010) found, 16 or fewer interviews is enough for studies with relatively homogeneous groups" (p. 38). In this case, the group's homogeneity was based on their positions as elementary science ambassadors.

All elementary GSA informants were notified about the study by email invitation (see Appendix C) via their official email contact information provided by the GADOE. The email script introduced me, described the study, included a copy of the informed consent form (see Appendix B), and provided a link to the online questionnaire by which candidates could electronically self-selected to participate in the study. Candidates who were interested in joining the study were directed to complete the online questionnaire, which consisted of three parts; the first section allowed respondents to indicate their informed consent and agree to participate in the research study; the second part consisted of seven items that gathered demographic data about participants (e.g., gender, age, years of teaching experience) and asked whether the respective school district was urban, rural, or suburban; the third section collected the respondents' contact information. A summary of the descriptive demographics of the research sample is depicted in Table 1.

Most of the participants identified as White/Caucasian females, and there was only one male GSA among the participants. This mirrored the national elementary school science teaching force, which is 94% female and predominantly white at 91% (Tio, 2018; Trygstad, 2013). Black, Hispanic, and multi-race teachers were overrepresented in the sample compared to elementary-level science teachers nationwide (Tio, 2018; Trygstad, 2013). However, the proportions of Black (13.3%) and Hispanic (6.7%) teachers in the sample were less than the

overall proportions of Black and Hispanic teachers in Georgia teachers, which were 20.8% and

10.1% respectively (Tio, 2018; Trygstad, 2013). The extent to which the sample mirrored the

population of elementary GSA is unknown, but the sample was not a matching representation of

the entire population of Georgia teachers. The largest districts represented in the study served

over 100,000 K-12 students, and the smallest district served less than 1000 total students. The 15

elementary GSA represented 15 school districts that served a combined total of 641, 200 students

at the K-12 level.

Table 1

Demographics of the Sample

Gender	Participants	Mean
Female	14	93.3%
Male	1	6.7%

Race/Ethnicity	Participants	Mean
White/Caucasian	11	73.3%
African American	2	13.3%
Caucasian/Hispanic	1	6.7%
Mixed	1	6.7%

Teaching Tenure*		
Minimum	Max	Mean
7 years	29 years	18.4 years

Context	Participants	Mean
Urban	1	6.7%
Rural	6	40.0%
Suburban	8	53.3%

District Size (Number of Students Served)				
Smallest	Largest	Mean	Median	Total of 15 Districts
< 1,000	> 100,000	42,747	20,900	641,200

* Grades/Levels Previously or Currently Taught
   Pre-K, 1st, 2nd, 3rd, 4th, 5th, Middle School, High School, College

Each of the self-selected GSA research participants agreed to engage in one semi-structured interview that was anticipated to last between 30 and 45 minutes. I was unknown to 13 of the 15 ambassadors prior to data collection and did not work directly with the remaining two GSA when the study was conducted, which helped to ensure that there were no issues with power and positionality.

Limitations, bias, and error. The study was limited in four ways, chief of which was the small sample size. Although the sample size was commensurate with the study's purpose and design, it was limited by how many and which Georgia Science Ambassadors were actually willing to participate. Due to the modest sample size and the qualitative nature of the research, the findings are not generalizable to a larger population or similar cases. The abiding interest of the study, however, was to gain an extensive and intensive knowledge about the single case with little desire to generalize (Stake, 1995). Temporality also limited the study in several respects. The finite timeline for study completion and the duration of the qualitative interviews limited the range and scope of data gathering. In his systematic review of how contextual factors shape leadership outcomes, Oc (2018) argued that the absolute or relative time that organizational research takes place is important for two reasons. According to Oc (2018), the *when* dimension of the research acts as an important proxy for contextual factors related to time effects, while social and economic relationships embedded in the leadership context are potentially shaped by events at the macro-level (e.g., leader succession, economic downturns, crises). The study was conducted approximately two and a half years after ambassadors were trained and the GSAP was launched. This could be construed as either an excessive interval of time for accurate data collection or a limited amount of time for GSA leadership outcomes to fully materialize.

A third limitation of the study was the selective criteria for participation. Elementary ambassadors comprised a mere one-fourth of the GSAP constituents, so their perceptions and experiences were not necessarily reflective of the overall group of ambassadors or the program as a whole. The study did not solicit the perceptions and experiences of district science leaders, building principals, and teachers who were not involved in the GSAP, which could potentially support or contradict those of the elementary science ambassadors. Finally, the study was localized to 15 public elementary schools in the state of Georgia, and only one of those schools was located in an urban setting. Despite these limitations, the collected data were relevant and sufficient to achieve the specific goals of the study. Each of these limitations also lend themselves well to future lines of inquiry, which will be addressed in the final section.

The study was prone to several types of bias, which I worked ardently to reduce. Response bias (Creswell, 2012) and selection bias (Collier & Mahoney, 1996) were two potential concerns. The elementary GSA were a finite pool of candidates representing 72 schools in 47 districts throughout the state. A low response rate for the initial questionnaire might have resulted in the selection of participants with overly negative or positive (i.e. biased) perceptions and experiences (Creswell, 2012). The response rate for the initial online questionnaire that was disseminated to all 74 elementary GSA was 20.1%, which also represents the overall percentage of elementary ambassadors that participated in the study. Participation bias, also referred to as non-response bias in survey research, may have resulted if the participating ambassadors differed from non-participants in disproportionate and meaningful ways. The 74 elementary GSA comprised 24.7% of the total population of 299 Georgia Science Ambassadors, and a full 20.1% of that elementary-level cohort was represented in the study. Based on the fact that one out of five elementary ambassadors participated in the study, I had confidence in the fair representation

of elementary GSA perceptions and experiences. Furthermore, elementary ambassadors were not evenly distributed across all 16 RESA zones. For nine out of the 16 agencies, the ratio of elementary-level to secondary GSA ranged from five percent up to 22.2%, and in six out of those nine agencies the ratio of elementary ambassadors was 20% or less. In other words, the sample of 15 elementary GSA (20.1% of all elementary GSA) matched or exceeded the percentage of elementary ambassadors in the majority of RESAs. This further enhanced my confidence that response bias and participation bias were minimal and the sample portrayed diverse perspectives and realities.

Researcher bias and expert bias were two additional pitfalls that had to be addressed. At the time of the study, I was employed as a science instructional coach and actively served as a Georgia Science Ambassador. I was conscious of the ethical predicament that existed where my research study intersected with my current position and ongoing GSA efforts. Although my embeddedness within the group of ambassadors facilitated access, rapport, and trust between me and participants, it also constituted an inherent bias. LaBanca (2011) attributed the naturally biased perspective of qualitative researchers to their close association with the data, sources, and methods used. Since researchers are guided by their own sets of beliefs and values about the world and how it should be understood and studied (Denzin & Lincoln, 1998), a variety of strategies must be used to overcome researcher bias, enhance the confidence of data interpretation, and curtail questions of credibility. I maintained analytic distancing and minimized confirmation bias (Sarniak, 2015) through bracketing, intensive self-reflection, openness to contrary evidence (Yin, 2014), and other critical feedback mechanisms that will be discussed in the following section.

Reliability, validity, trustworthiness, and credibility. Denzin and Lincoln (2005) described qualitative research as an endlessly creative and interpretive practice wherein making sense of one's findings is both artistic and political. While that may be the case, I strived to address the critical issues of representation and legitimation by leveraging the multiple criteria that exist for evaluating qualitative research (Denzin & Lincoln, 2005; Drost, 2011). Validation, which attempts to judge the accuracy of research (Creswell & Poth, 2018), has been described in the current study with terms that are congruent with qualitative work (Creswell & Poth, 2018). I used evaluative criteria that aligned with an interpretive-constructivist paradigm – *trustworthiness*, *credibility*, *transferability*, and *confirmability* – in place of positivist equivalents like internal and external validity, reliability, and objectivity (Creswell & Poth, 2018; Denzin & Lincoln, 2005; Lincoln & Guba, 1985). Triangulation, member checking, and reflexivity were three specific processes that allow those criteria to be met.

Triangulation of multiple data sources, methods, and theories reinforced the accuracy and credibility of the study (Creswell, 2012) by corroborating evidence (Creswell & Poth, 2018) and identifying and clarifying multiple realities and perceptions (Denzin & Lincoln, 2005). Member checking, also called respondent validation, was used to solicit feedback from the study participants and verify the accuracy of the research (Merriam, 2009). According to Stake (1995), actors can play a major role in directing the case study by making suggestions, triangulating the researcher's observations and interpretations, and reviewing materials for accuracy and palatability. I took a preliminary analysis of the data back to some of the research participants to check whether my interpretations and account were fair, representative, complete, realistic, and accurate (Creswell, 2012; Creswell & Poth, 2018). I asked the study participants if they were able to recognize their experiences in the interpretation, the extent to which the interpretation

"rings true," and whether they had suggestions to fine-tune the interpretation and better capture their perspectives (Merriam, 2009).

Reflexivity, also known as researcher's position, acknowledges one's self as a research instrument (Merriam, 2009). It is critical self-reflection about how one's own knowledge, prior experiences, personal interests, biases, theoretical predispositions, intentions, positionality, limitations, situatedness, and other such qualities may impact research processes and activities (LaBanca, 2011). It was imperative for me to critically reflect on the biases, values, privileges, prejudices, experiences, and orientations that I brought to the qualitative research, which I then disclosed to the readers so they could appreciate how those factors likely shaped the inquiry (Briggs et al., 2012; Creswell & Poth, 2018). I accomplished reflexivity in two ways. First, I provided a detailed narrative of my personal experiences and perceptions as a GSA (see Appendix L). By illustrating a thorough account of my own journey in the ambassador program, I provided transparency and perspective regarding any motivations and biases underlying my research. Secondly, I used reflexive journaling throughout the study. A handwritten journal allowed me to chronicle my thoughts and feelings, contemplate the implications of my positionality and emic perspective, and provide an audit trail at the conclusion of the study. High quality reflexivity is indispensable to the trustworthiness of any qualitative study (Carcary, 2009; LaBanca, 2011) because it accounts for the investigator's reliance on his own interpretation of observed and recorded data, such as events, situations, and the actions or interactions of various actors (Denzin & Lincoln, 1998).

Physical and intellectual audit trails allow other researchers to validate or challenge research findings, construct alternative arguments, or contribute to and extend research (Briggs et al., 2012). Audit trails also increased the trustworthiness and confirmability of research findings

(Bowen, 2005; Carcary, 2009; LaBanca, 2011). The reflexivity journal and memos provided an intellectual audit trail, evidence of my frames of mind, metacognition, interpretations, and how my thinking evolved throughout the study (Carcary, 2009). In addition to the reflexivity journal, I maintained a detailed record of all research activities by documenting every stage of the study, from contacting research informants to data collection and analysis procedures. In accordance with the American Psychological Association's (2010) established guidelines, all data were securely retained throughout the study, and upon request, certain data shall be promptly and openly shared among qualified investigators. However, the privacy, welfare, and confidence of all research participants were and are of utmost concern to me, so informants' identities shall not be disclosed by me at any point in time without their express written consent. Proper steps were taken to secure and protect any and all confidential information, including de-identification and anonymization of data (Buckman & Gold, 2012; Nelson, 2015). Data contained in interview transcripts were de-identified and physically secured in a separate location from signed consent forms. Digitally stored information were de-identified, encrypted, and password protected. All research data will be destroyed three years after the closure of the study.

Data analysis and interpretation of findings. This section explains the analytic and interpretive process used to establish the major themes and draw inferences from the data. I sought to capture the perspectives of GSA informants and use them to illuminate the GSAP. As such, the study assumed a relativist orientation, which acknowledges multiple realities, with multiple meanings, and findings that are based on those observer-dependent realities (Yin, 2014). Data analysis was conducted within an interpretivist-constructivist epistemology based on the belief that knowledge is constructed rather than discovered. Distributed instructional leadership theory and systems theory were jointly applied as a framework for data analysis; this customized

the data analysis process to address the research questions and determine whether and how ambassadors' instructional leadership competencies have been developed (Honig, 2012), distributed (Klar, 2012), and supported within a complex and multi-tiered system. As the data painted a clearer and more sophisticated reality of the GSAP based on integrated interpretations and experiential reality, my central role became that of interpreter and gatherer of interpretations (Stake, 1995). The critical analysis of ambassadors' personal accounts and recollections elicited a discernible sense of the substantive nature of their work, including specific practices and supports that have either benefited or impeded the GSAP mission.

My emic perspective and GSA experience allowed me to identify germane categories and themes that aligned with the research questions, and I conducted an extensive literature review on each. The three dominant categories included (a) distributed instructional leadership (Harris, 2007; Klar, 2012; Halverson & Clifford, 2013), (b) positionality and power as they relate to boundary-spanning activity (Coldren & Spillane, 2007; Tushman & Scanlan, 1981), and (c) support for achieving policy initiatives (Mac Iver & Farley, 2003). Each category represented a useful analytical and interpretive filter that was used to identify, organize, and analyze various aspects of ambassadors' work, such as professional learning, cognitive sensemaking, reform-based science standards, problem-framing, capacity building, authority and discretion, voice and autonomy, etc. Although I preliminarily identified pertinent topics that I expected to be revealed during data collection and analysis, I was surprised by the emergence of several unexpected and salient themes. Distributed instructional leadership, power and positionality, and support for policy initiatives served as three preeminent interpretive lenses for the study since they were complementary, they contextualized the research questions, and they encompassed an array of other research-based, relevant themes.

I used a sophisticated computer-assisted qualitative data analysis (CAQDAS) program known as NVIVO 12 to simplify data management and assist with data analysis; the software package was used for several stages of analysis, including text searches and queries, identifying codes and patterns, developing concepts and categories, recording memos, exploring connections and relationships within the data, and synthesizing the categories and sub-categories into themes. Prior to using the NVIVO 12 software, I familiarized myself with the data and began a preliminary analysis by reading, highlighting, and annotating printed copies of each interview transcript. I used reflective memos to record questions about and impressions of the data. I then re-read each transcript, highlighted and annotated sections of text that emerged across multiple interviews. Following the preliminary analysis, a two-phase coding technique (i.e. first-cycle and second-cycle) was used to code and analyze the data using the NVIVO software.

During first-cycle coding, a combination of provisional, structural, and values coding was employed to achieve exploratory, elemental, and affective data analysis methods, respectively (Saldaña, 2016). The following paragraphs provide brief descriptions and applications of the three analytical methods and the specific coding styles that were accomplished.

Exploratory methods assign tentative labels to the data as they are initially reviewed, and the preliminarily assigned codes are later refined by more specific first or second cycle coding methods (Saldaña, 2016). For the GSAP case study, a predetermined start list of five initial codes was generated from the literature review and research questions, and those initial categories were used to begin the process of "lean coding" (Creswell, 2012; Saldaña, 2016). The five provisional codes included (a) Preparation, (b) Active, (c) Support, (d) Leadership, and (e) Challenges. These were intended as broad designations that would encompass more specific sub-codes that related to the provisional start codes. For instance, *Preparation* was used to code

any data related to formal professional development received by ambassadors, but it also included mention of advanced degrees and endorsements, grade levels taught, and previous career experience. The label *Active* was initially used for excerpts about conferences and curriculum development, but it expanded to include collaboration, grant-writing, and social networking.

Elemental methods, such as structural coding, apply basic but focused filters and build a foundation for future coding cycles. Structural codes were used to selectively label and categorize segments of data that related to the literature review, research questions, and interview protocol. Structural coding, which is more commonly known as utilitarian coding, is particularly suitable for coding interview transcripts that were obtained through semi-structured data-gathering protocols (Saldaña, 2016). A few examples of structural codes that related to the literature review and guiding questions include *emphasis*, *formal leadership*, *informal leadership*, *positionality*, and *capacity*. Structural codes were used to both code and initially categorize the transcript data, which allowed me to decipher commonalities, differences, and relationships between comparable segments of data (Saldaña, 2016). The process of structural coding expanded the original five start codes to a field of more than 40 categories, at which point no additional unique codes surfaced. The 40 categories were eventually reduced, consolidated and refined to five major themes. Table 2 shows the list of structural code categories generated from first-cycle coding.

Table 2

Categories of Structural Codes Generated During First-Cycle Coding

*Preparation	* Active	* Support	* Leadership	* Challenges	* Perceptions of…
Background	Acquired	Emphasis	Formal	ELA & Math	GADOE Training
Grades Taught	Collaborate	Engagement (S)	Informal	Emphasis	Self
Becoming a GSA	Conference	Engagement (T)	General	PL	Science GSE
Selection	Delivered	STEM	Positionality	Capacity	Other Teachers
Opportunities	Grants	5-E Model	Trust	Time	Administrators
Passion		Testing		Not Utilized	GSA Description
		EdWeb			General

Values coding taps into the inner cognitive systems of participants and is especially appropriate for exploring the intrapersonal and interpersonal participant experiences in case studies (Saldaña, 2016). Values codes were attached to data that reflected ambassadors' emotions, beliefs, attitudes, and perspectives about any person, thing, or concept.

As I interacted with the data, I drew from Braun and Clarke's (2006) six-phase guide to thematic analysis, which described the process as ongoing, organic, and recursive. Recurring patterns emerged during the coding and data analysis processes, and I used them to establish themes that related to ambassadors' perceptions and experiences. The data also particularized and expounded some of the research-based themes that were initially examined in the literature review, such as problem framing and professional learning.

Second-cycle coding methods (Saldaña, 2016) allowed me to reorganize and reanalyze the coded data, gain a sense of the categorical, thematic, and conceptual organization of first-cycle codes, and progressively transform the codes and sub-codes into categories, themes, and eventually assertions. A blend of pattern coding, focused coding, and axial coding was used

during second-cycle coding to develop labels for similarly coded data, construct categories based on thematic and conceptual similarity, describe the categories' properties and dimensions, and explore how the categories and subcategories related to one another (Saldaña, 2016). This allowed me to condense and refine the categories to produce five primary themes and 20 total sub themes, which directly and indirectly related to the study's guiding question. The types and levels of support and leadership given to ambassadors were deduced from the frequencies and qualities of codes that fit within (a) the experiences and opportunities of "Being a GSA," (b) the challenges they faced, (c) the leadership they enacted, (d) the measures of support they reported, and (e) the advice they offered.

Documents, audio-visual resources, and digital artifacts were analyzed concurrently with interview data using holistic, structural, and concept coding methods. Specific examples of how the data were triangulated are provided in the section titled Secondary Source Analysis and Triangulation of Data. Finally, at the conclusion of my data analysis and interpretation, an independent reviewer analyzed portions of the data and verified the emergent themes.

Findings

The case study of the Georgia Science Ambassador Program answered both of the research questions and revealed unexpected and surprising findings. The following two questions guided the case study:

1. What are the perceptions and experiences of Georgia Science Ambassadors about the distribution of leadership and support and how it has influenced their ability to lead the implementation of the Georgia Standards of Excellence (GSE) for Science?

2. How do Georgia Science Ambassadors describe the levels and types of support they have received for implementing the new Georgia Standards of Excellence (GSE) for Science?

Although Georgia Science Ambassadors have been given the responsibility of rolling-out the new Georgia Standards of Excellence for Science, the extent of their efforts has largely depended on whether and how other leaders empowered and supported them. A preponderance of the evidence showed that, although ambassadors tended to perceive themselves as having an increased capacity for instructional leadership, the overwhelming majority of them have been underutilized and limited in their efforts to implement the Georgia Standards of Excellence for Science.

Five salient themes emerged from the analysis of ambassadors' perceptions and experiences about their instructional-leadership roles and the types and levels of support they have received. The coded interview data particularized ambassadors' perceptions about their (a) experiences and opportunities, (b) challenges faced, (c) leadership enacted, (d) support received, and (e) advice offered. The underutilization of ambassadors was an overarching and integrative theme which threaded the five categories together into a coherent and compelling narrative (Saldaña, 2016). That narrative is presented as *The Case of the GSAP*, a subsection of the findings that includes a detailed analysis of each emergent theme, interview data, and supporting quotes from ambassadors.

The findings revealed that elementary-level GSA have been largely marginalized by principals and occasionally by district leaders. Leadership responsibilities were sparsely distributed to the ambassadors, and many of the GSA have received limited support for implementing the Georgia Standards of Excellence for Science. Considering the moderate to

high levels of trust reported by ambassadors, this finding presented an interesting paradox. Although most ambassadors perceived at least a baseline level of trust from their building or district leader (as indicated by their leaders offering high recommendations or personally selecting the GSA for the program), those same ambassadors reported being underutilized. This finding advanced the systems-view conceptualization of ambassadors' work as being multiplex parts, ties, relationships, and interactions. A selection process, personal and organizational trust, leaders' recommendations, and ambassadors' competence were merely a few interconnected pieces of an impressive policy-leadership puzzle.

A particularly surprising finding was that even in cases when leadership and support were distributed to ambassadors, they were usually mediated by other systemic factors and variables, which ultimately deterred policy implementation. These factors included time constraints, conflicting priorities and initiatives, teachers' readiness and receptivity to the new standards, and capacity for implementation in terms of funding and resources. In other words, even when leaders' decisions and actions supported GSE implementation, the standards policy was not always implemented with fidelity. The types and levels of distributed leadership and support rendered were not a reliable determinant of implementation success. The diagram in Figure 3 illustrates the rarity of circumstances that were conducive to GSA efforts (i.e. distribution of leadership and high levels of support) and the major finding that even ideal circumstances did not ensure successful GSE implementation. This finding supports the notion that policy implementation is a fragile process that unfolds in a complex network of systems and subsystems where every part and process potentially influences all others. This also suggests a need for educational leaders to have a capacity for systems-thinking.
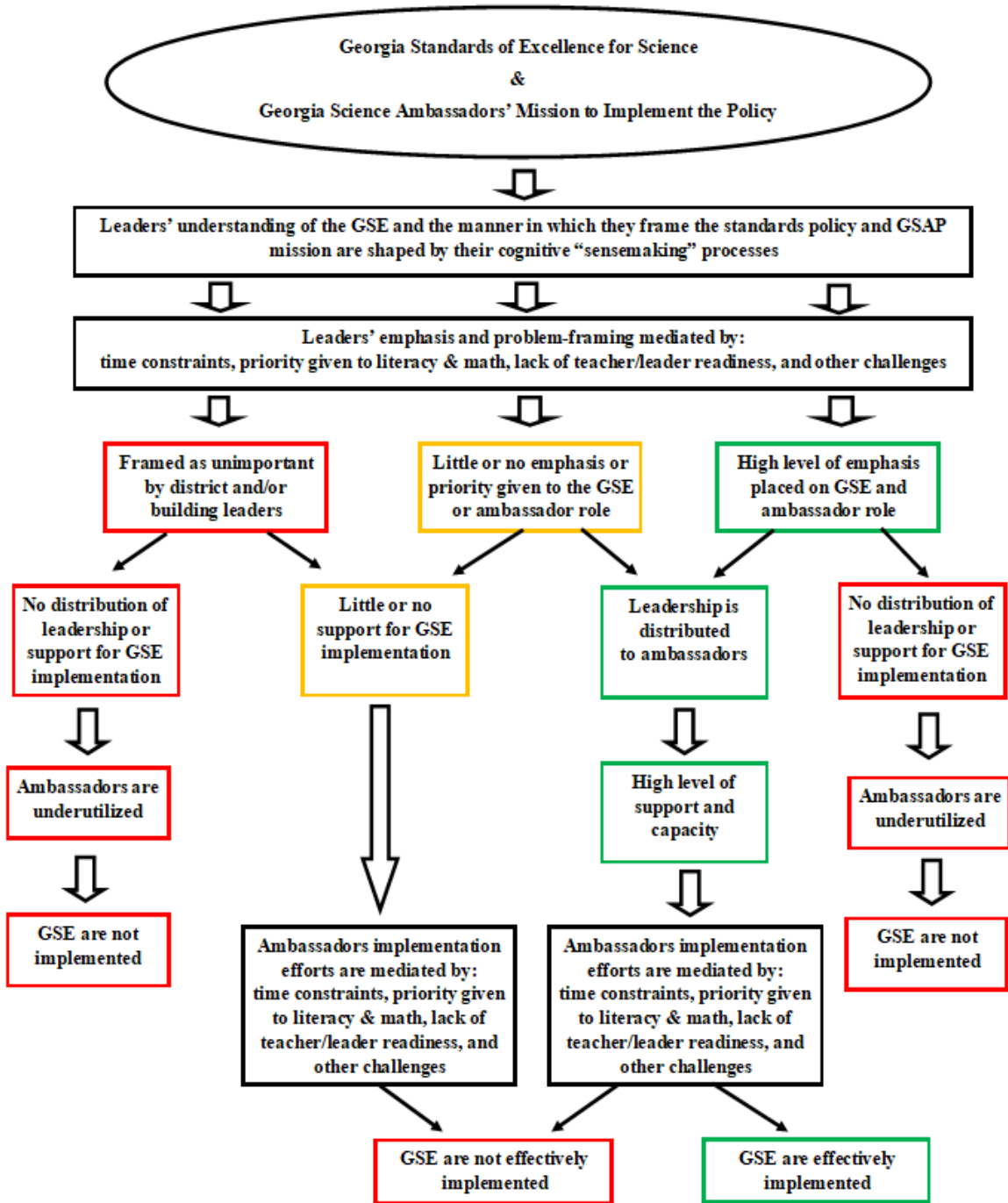
Figure 3. Systems view of leader inputs, mediating factors, and policy outcomes.

Surprisingly, principals have been inconspicuous figures during the first two years of GSE implementation. The vast majority of participants who were able to carry out some form of training or redelivery in their school buildings, albeit limited in scope and duration, claimed that their principals did not attend, nor did they participate. The elementary GSA study participants also perceived a much higher need for additional professional learning and support compared to what their administrators and teacher colleagues believe was warranted. Finally, the findings align with those of Wang and Hendrick (2017), which revealed that ambassadors are not facilitating the flow of information across advice-seeking network paths. At the same time, the findings dispute their assumptions that, as time passes, more teachers and leaders will engage with the science standards and ambassadors will be integrated into the advice-seeking network. However, elementary ambassadors are highly passionate about inquiry-based science instruction and the instructional leadership potential they hold for implementing the GSE for Science.

The following sections explore the major and peripheral themes that were identified and extracted from the data analysis. Selected quotes from the study participants were inserted to clarify my interpretations and support my judgements and assertions; the quotes also provide evidence of the five themes as integrative elements that have resulted in missed opportunities, unrealized potential, a few isolated examples of progress, and some hopeful advice for GSAP success.

The Case of the GSAP

About the GSA. The pool of ambassadors was extremely diverse in terms of background, content knowledge and expertise, professional roles, leadership competencies, autonomy and authority, professional development experience and presentation skills,

involvement with policy, and the characteristics of their respective school districts (e.g., size, financial capacity, organizational culture, etc.). Over 260 coded items described ambassadors' professional backgrounds, training experiences, degrees and certifications, opportunities, and self-efficacy. These qualitative descriptors established the concept of *GSA Experiences and Opportunities*, a category that portrayed the ambassadors as they saw and described themselves.

At least one-third of the study participants chose teaching as a second career, and those individuals brought with them knowledge and skills from the fields of science, engineering, natural conservancy, professional authorship, and law.

Elementary GSA are highly passionate about their field, and they feel poised to accomplish the GSAP mission. There were 63 coded references for *Passion* across all 15 interviews, which included the terms passion, excited, fantastic, love, hyped, a cause, a calling, eager, and science nerd. As Ms. Alley exclaimed:

> It's like a cause or something for me, it really is, because I feel like our students are being cheated. Kids shouldn't grow up without experiencing all these wonderful things that science has to open their mind and change the way they look at their world, and if they're missing that, we're robbing them, we're cheating them, and it shouldn't be happening. It can absolutely change the course of their life and who they become and how rich their thinking is as they go about their everyday life. I mean this is where we dig in and teach that, and if they're missing that, that's a crime.

Of the 15 study participants, one GSA was a teacher on special assignment at the district level, another was a school-based science coach, two individuals taught STEM-focused classes, and the remaining 11 were general education teachers. All 15 participants believed that the GSAP mission must continue, and they each expressed a personal desire to contribute to that effort.

Five of the classroom teachers hoped to eventually become science leaders above and beyond their school setting.

Ms. Gifford indicated, "I want to be the TSA (Teacher on Special Assignment) that goes into those schools and does that one-on-one training."

Ms. Hudson offered:

I would love to move to a level where I am completely supporting teachers, with my role being as a support staff, not within the classroom teaching. My role would be out there helping them, coming in and supporting, teaching side-by-side lessons with them, just encouraging the teachers in teaching science, especially at the elementary level.

Similarly, Ms. Henson had asked her principal if she could become the science coach at her school, and Ms. Banke exclaimed that she would work for the county or state in a heartbeat. Ms. Elliott also shared that she would desperately like to move beyond the classroom to support 3-D science on a broader scale. Each GSA expressed a zeal for the GSAP vision and functioned as a support unto him/herself. The participants demonstrated a relatively high level of ardor for 3-D science instruction and GSE implementation, which is arguably a requisite support for GSE implementation. Every interviewee expressed as much confidence as they did fervor, and some referred to themselves as experts, gurus, and knowing their stuff. It was interesting that several participants highlighted the fact that they know where to go to get desired information or resources, whereas their general education counterparts do not. Experts typically know where to look for resources and help, which tools are available, who in their network has specialized expertise that they can call upon, and they see relevant and useful information in their environment, which makes it easier for them to gain even more knowledge expertise (National Academies of Sciences, Engineering, and Medicine, 2018). It was plausible that personal,

professional, and contextual factors had implications for the manner in which ambassadors' implementation work unfolded. A few of the ambassadors attributed their enthusiasm and expertise to their professional backgrounds, but others gave at least partial credit to the GSAP training.

GSA preparation. I considered that the professional development that all science ambassadors received was a central support mechanism, so participants were prompted to share their thoughts about their GSAP preparation. As a follow-up to their response, they were also asked whether the training changed their understanding of science standards, science instruction, and professional learning for science. Ambassadors described their preparation and training as mostly beneficial, but for the most part it did not alter their understanding of science learning standards or science instruction. Most ambassadors claimed that they had an affinity for hands-on science education and that they emphasized inquiry-based science prior to becoming a GSA. Mr. Grady believed that, "The ambassador training was more professionals getting together to hone their skills…it was more we were the people who already knew science, more than training us on the new standards." Ms. Griffeth also admitted, "I don't think it changed how I looked at it because I always thought of science as a verb." Several ambassadors acknowledged that the training helped them understand the changes in the science standards, the intent of the GSE, and ways to adjust and improve their science instruction. Ms. Banke offered this description of the GSAP training:

> I mean it was so good. It was, it just opened your eyes to different things and different ways of teaching that you knew that you were doing, but then you didn't realize that there was actually a name for it, and it gave you some tips and ways to focus in on just exactly what the kids needed. And it was just so fantastic.

Other participants offered similar descriptions, which were either generally positive or neutral. For example, Ms. Castanza said, "It made me very aware that there is a change in the view of the new standards" and Ms. Henson indicated that, "It just showed me more ways to go in depth, and I liked a lot of the ideas they presented."

Not all of the GSA perceived their training as a wholly positive experience. Ms. Jennings said that, *"Even though some of the trainers were good, it kind of felt like nobody was really exactly sure where they were going with it, what it was really going to look like in the end."*

The following viewpoint offered by Ms. Meyer resonated with me and provided a representative voice to other elementary ambassadors that were not part of the study. According to Ms. Meyer:

> The first training that we went to...it completely plowed me under and made me feel so incompetent. I just felt like, what was I thinking? I have no business here. I don't. This is awful. I'm embarrassing myself. I mean, it was, it was, oh my gosh. And then later talking to other people, I found out a lot of people felt that way in the beginning. But I hung in there, and the training was, was very valuable.

A latent characteristic of Ms. Meyer's observation was that many ambassadors were unaware of the agenda and expectations when they arrived on their first day of training. Ms. Henson indicated that "It felt like they were wanting us to do a lot of the work and writing lessons, and coming up with experiments and inquiry activities…it felt sort of like we were being used a little bit." Other ambassadors also commented on the curriculum design aspect of the GSAP, such as Mr. Grady stating that, "I felt like we were there to more create a framework than

we were to learn anything" and Ms. Blakeman saying that, "Them asking us to write curriculum was like out of left field."

At least one GSA felt like they were talked down to during the training, another described the use of "highbrow science" (i.e. scholarly, academic language that is incomprehensible), and a third individual noted the inadequate time for digesting the content and developing curricula. Ms. Smithson said, "I don't feel like they gave us enough time to really plan things that others can use." The three ambassadors that shared negative perceptions also had positive input about the training.

The GSAP training may not have entirely shifted ambassadors' conception of science instruction, but the majority of participants did agree that the training changed their understanding about what science professional learning should look like. Most ambassadors shared thoughts similar to this one by Ms. Hudson:

> I really like the professional learning where you become a student, where you're doing the labs, and where you are experiencing the same things that students would experience. Because when you do that, you understand their struggle, and when you understand their struggle, you can better come in and help them.

Ms. Griffeth indicated that, "That was probably my first experience like with some very powerful PD," while Ms. Elliott stated that, "You're feeling it, tasting it, smelling it, you're just jumping all in it."

There was also evidence that elementary GSA's fresh conceptions of science professional learning have translated into their implementation work. For the eight ambassadors that were able to conduct at least some manner of professional learning for the GSE, all of them reported that teacher participants were excited about, receptive to, and complimentary of the training.

Ms. Banke indicated that, "It went great! They were thrilled over the science training. I mean, just thrilled." Likewise, Ms. Blakeman stated, "Lights were going off. Laughter. They were enjoying and learning, like what we want our kids to do." Finally, Ms. Gifford said, "These teachers could not wait to go back, not only to integrate some of the activities that they saw, but to change up some of the activities they had already been doing in their classrooms."

The positive feedback from ambassadors and their colleagues was encouraging, but it was most often tempered with negative sentiments about the challenges that impeded their professional learning efforts. For example, Ms. Alley stated that, "I thought some of the training was really, really good, but I think that the expectations for redelivering it were not reasonable for teachers to really grasp the idea." Professional learning for the GSA was perceived as both a support and a challenge, but ambassadors perceived many other types of support besides professional development. The following sections will include a discussion of how the GSAP mission was supported and an examination of the challenges that eclipsed that support.

Support and encouragement. Ambassadors perceived different types and extremely disparate levels of support. There were 63 individual codes for *support received* that stretched across all 15 ambassadors, and those codes mostly related to curriculum, framing and emphasis, guidance, and professional learning. Six of the participants had only one positive reference to support, there were two *support* codes for another GSA, and one person had two references. There was an exaggerated margin between those eight individuals and the participant with the highest frequency (13) coded references for support. The typical ambassador who felt supported had between six and eight coded excerpts that related to various support mechanisms. Sources of support included principals, colleagues, other science ambassadors, district leaders such as science coordinators, academic coaches, and even a superintendent. Ms. Banke said, *"I'm very*

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lucky that my principal's understanding, and if I need coverage he'll find me the coverage to do it." Additionally, Mr. Grady noted, "That's the support though, is having a principal or superintendent when you go, 'Hey, if you get an email, can you please open it and say yes, because I'm trying to apply for a grant?'"

Mid-sized and large districts typically had a designated science curriculum leader, and that person tended to offer moral support and encouragement even when tangible resources were scarce. Some examples include:

Ms. Alley: "Our science coordinator is fantastic. She is an advocate for her teachers on special assignment, which is myself and the secondary, for the teachers, for the students. She is all in 100 percent."

Ms. Blakeman: "My curriculum coordinator made me feel like I had value and that is something I'll always be grateful to her for."

Ms. Keller: "If it wasn't for him and having that person to talk to that has more knowledge...I don't know if I could do this on my own."

Although smaller districts tended to receive less support than their larger suburban counterparts, there were a few interesting exceptions. Participants from several of the medium and large districts reported very little support, yet the participant with the highest frequency for support received was located in a small, rural district. Two participants credited the state department with ongoing support with Ms. Gifford saying, "Like the DOE science director herself, and the support that you get…when I've had questions, you can very quickly get a response back."

Various institutions also played a role in supporting and furthering the GSA mission, including the Civil Air Patrol, Captain Planet, Georgia Power, the Georgia Youth Science Technology Consortium (GYSTC), Georgia Science Teachers Association (GSTA), Master

Gardeners Associations, Regional Educational Service Agencies (RESA), Tellus Museum, and the Fernbank Science Center and Museum. Some ambassadors worked individually to forge partnerships with these organizations or nearby colleges and universities, and some of them received grant funding, materials and supplies, and training. Three participants mentioned parents as a support. Ms. Jennings said, *"We have really good involved, supportive parents here, so pretty much anything we asked for we get, I mean, you know, within reason."*

Notwithstanding the many forms of available support, and despite the fact that some study participants perceived high levels of support, the support rendered paled in comparison to the challenges that elementary science ambassadors face. The next section outlines the unforeseen hurdles and barriers that awaited the GSA, the specific challenges that ambassadors faced as they undertook the GSAP mission.

Challenges faced. There were 503 coded segments of interview transcripts associated with *Challenges*. The data revealed six major challenges that constrained the work of the elementary-level GSA. Those six challenges, in order of the most cited to the least referenced, included (a) the Science GSE not being a priority, (b) lack of capacity in terms of resources and funding, (c) teachers' readiness for and resistance to the new standards, (d) time pressures, (e) minimal guidance and coherence for implementation, and (f) restricted professional learning opportunities. A description of each challenge, as well as its interconnectedness to the other five, has been provided.

Science GSE as an afterthought to literacy and math. Stiles and colleagues (2017) argued that science education should not be isolated from the other disciplines, but that appears to be exactly what has happened in Georgia. All 15 participants expressed a concern that literacy and math instruction received a disproportionately high level of emphasis with little or no

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priority given to Science GSE implementation. The largest portion of these, 119 codes, were

categorized as Priorities. Of the 119 priority codes, 72 were included in the sub-category GSE

Not a Priority, and the remaining 47 references spoke to the Emphasis on ELA and Math. "The

most unfortunate thing I think about elementary school, is that we take so much of our day and

we spend it in ELA and math," Ms. Alley said, while Ms. Smithson noted that, "First of all,

there's not enough professional learning for teaching science out there. Most everything seems

to be revolved around reading or math."

The preceding comments implied that principals may not be entirely to blame. The low

priority given to the Science GSE may be the result of high-stakes accountability for literacy and

math, leaders never having received training on the GSE, or a general lack of clarity and

coherence for rolling out the standards. The data suggested that most principals are uninformed

about the language of the GSE, 3-Dimensional Teaching and Learning practices, the Georgia

Science Ambassador Program in general, and the best way to utilize their ambassadors for

implementing the new standards. Ms. Gifford suggested that, "If they understood what this was

supposed to look like, they might give it a bigger priority."

This may have been a simultaneous cause and effect of the emphasis placed on literacy

and math at the national, state, and district levels, which in turn resulted in a lack of guidance,

coherence, capacity building, and professional learning for implementing the Science GSE. In

fact, any one of the six challenges may have predicted or manifested from any of the others.

This demonstrates the interdependent and systemic nature of the variables that have influence

ambassadors' work, and it also exemplifies why it is impossible to pinpoint one definitive cause

of implementation failure or success. It is important to note that, although it was not within the

scope of this study to determine why leaders have not prioritized the Science GSE, it was

apparent that some principals showed little or no interest in science, the GSE, or the GSAP. For instance, Ms. Henson relayed that, "My principal asked me, he goes 'What is this all about?' He said, 'Okay, remind me tomorrow, I'd like to talk to you about it.' So I reminded him but I never heard from him again about it." Or Ms. Blakeman commenting that, "I would say the elementary curriculum and school improvement person doesn't think science is important."

One indication of the nominal emphasis placed on the Science GSE was that leaders did not typically attend or participate in training. If a participant disclosed that they had conducted any type of professional learning for the GSE, they were asked whether their principal was present or engaged in the training. The vast majority of participants who were able to carry out some form of training or redelivery in their school buildings claimed that their principals did not attend or participate. As an example, Ms. Gifford said, "If you asked my principal, she would tell you it was important. But does she show that support? She's never been into a training herself to understand truly what this needs to look like."

There was no speculation about why principals were largely absent, but one possible reason is that science is a state-tested subject only in fifth grade. The interview protocol did not inquire about the accountability or testing, but there were 18 coded references to state mandated testing from six different participants. As such, Ms. Keller stated that, "I've sat in plenty of meetings where I've heard, well we need to focus more on reading and math, you know. Well you're not tested on science and social studies, so don't worry so much about that."

All six individuals felt strongly that the Science GSE would be more of a priority for educational leaders if it was a tested subject in the lower grades. However, it is worth noting that four of those ambassadors also expressed mixed emotions about that claim, adding expression like "I hate to say it," "it's a shame," "it's sad," and "I would not be supportive of it." It was

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apparent that these GSA felt conflicted about the pros and cons of testing, and the following two excerpts are a testament to their dilemma. Ms. Jennings explained:

> If you were gonna tell me, hey, at the end of second grade your kids are going to have to sit and take a standardized test on the life cycle of a butterfly, that is not going to positively impact my instruction in second grade. What that is going to do is that's going to turn my instruction into a very paper pencil rote memorization.

In Ms. Jennings's view, a state sanctioned test for science would transform her instruction in a way that defeats the purpose of the Science GSE. Others were concerned that science is not being sufficiently taught in the lower grades and that standardized testing might remedy that. As Ms. Meyer said, "It's not a priority for administration. It's not a priority for people at the board levels, and it's not just my county…if it's not being tested, they don't really put a focus on that." Ms. Meyer reasoned that a priority and focus due to testing would likely entail an increased capacity for GSE-based science instruction. *Capacity*, which is undoubtedly shaped by administrators' priorities, had the second highest frequency of codes at 111 and was arguably the second most important challenge to elementary ambassadors.

Limited capacity for leading GSE implementation. Ambassadors' formal instructional-leadership capacity was partly determined by the types and levels of leadership and support that were distributed to them. Capacity is a broad concept that encompasses funding and resources, time and opportunities, preparation and training, support and empowerment, and other systemic variables. Since time challenges and GSA preparation were each addressed separately in this report, the discussion about capacity will pertain only to funding, resources, equipment/supplies, and opportunities for GSA to redeliver professional learning for GSE implementation. Despite the fact that elementary science ambassadors perceived themselves as highly competent, capable,

passionate, and eager to lead, district leaders did not always leverage or expand the capacity of their GSA. Ambassadors received disparate types and levels of funding and other support, but the inequities that existed between districts only partially corresponded with district size and context (e.g. rural versus suburban). There were also disparities within single districts, which was made clearly evident by ambassadors who changed from one school to another within the same school system such as Ms. Alley, who noted that, "At my first school, it was just so easy…if ever I needed time off, it was never an issue. At my new school, and that's what most of the schools are like, is they get no help." The types and levels of support that were rendered depended on how leaders' beliefs and values aligned with the purpose and vision of the GSAP.

The three largest districts ($\geq$ 50,000 students) and three medium-sized districts (18,000 to 50,000 students) reported high levels of funding and a ready supply of science equipment and materials to support GSE implementation. At least one small district reported ample support.

Ms. Elliott: "If there's anything that we do not have accessible here at our school, all we have to do is get in touch with our head science director and they will supply us with whatever it is that we need."

Ms. Spicer: "We have a warehouse of science stuff."

Ms. Smithson: "Our principal is great about getting us materials that we need."

At the same time, three other medium-sized districts and most of the smaller districts ($\leq$ 10,000 students) described limited funding, equipment, and supplies. Ambassadors from the mid-sized districts claimed that teachers are frustrated by the lack of funding and science equipment. They said:

Ms. Alley: "It's always the biggest complaint of the teachers, is that we don't have the supplies to do what we're supposed to be doing."

Ms. Keller: "Like we're spending our own money just to be able to teach the content, and there's no money support, no money for like lab equipment."

Ms. Gifford: "Funding? What funding? Well, my personal budget at school is cheap to free."

Mr. Grady: "Right now I'm working off recycled cardboard and materials that I'm finding or anything that I found that teachers don't use. I collect. I might as well be a Captain Planet classroom."

Several ambassadors explained that the challenge is not so much the availability of funding and resources as it is the bureaucracy and red tape involved in ordering equipment and supplies. Ms. Meyer explained that, "They say they'll buy us whatever we need, but the problem is the chain that it has to go through…there's money there, but it's just the process, the waiting, the red tape." The mention of bureaucracy and red tape attests to the multidimensional and systemic nature of each identified challenge. Similarly, this statement by Ms. Jennings exemplifies the intersection of capacity, funding, educational level, and priorities:

Like if our grade level gets $5,000 for the whole year, say for example, and we have to purchase all of our materials out of that money, then basically what happens is you go, okay, so where am I going to get the biggest bang for my buck? Am I going to buy reading workbooks, or am I going to buy science equipment? And so most primary teachers are going to say we're going to buy reading workbooks.

Rural areas tended to have significantly less funding and equipment, but some of those districts supported their ambassadors by sending them to professional conferences, endorsing and approving grant requests, and provided time and opportunities for the GSA to conduct professional learning (PL).

Capacity for implementation was also tied to teacher readiness and resistance, a third challenge that will be discussed in the next section. For example, even though some districts had capacity in terms of science equipment, it was not always utilized by teachers. One ambassador recalled intervening when new and used science equipment was going to be senselessly discarded. Another recounted pulling serviceable science equipment from a dumpster. Three other ambassadors told about the science equipment, which they procured through grant-funding, sitting on stages and in storage closets, never having been used. Ms. Alley cited this as the reason why her district office stopped purchasing science equipment, saying, "These science kits are back in closets, and so that's why the district won't buy new stuff is because they're like, guys, you have this stuff in your school."

Ironically, some of the same ambassadors that reported limited funding and equipment admitted that teachers in their buildings did not regularly use the equipment that was available. Mr. Grady noted that, "We have three rain gauges in our supply closet still in the plastic from seven years ago" and Ms. Alley's commented that, "I have all four stream tables in my room because everyone's too intimidated to try them."

The capacity of ambassadors in terms of time and opportunities, especially for formal leadership (i.e. conducting PL), was linked to funding, positionality, and leader framing (i.e. GSE not being a priority). Ms. Worthington believed that her capacity to act as a formal and informal leader may have been limited because she was never officially introduced as a GSA. Ms. Worthington said, "Most of the staff didn't know I was a Science Ambassador. They didn't even know what that was."

Perhaps the decision-making processes that have limited or omitted science professional learning are partly attributable to the confluence of power, positionality, and leadership within

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the instructional reform policy agenda. Several participants acknowledged that their position as a classroom teacher severely curbed their GSAP efforts. There were 49 coded data segments for *Positionality*, 23 of which pertained to the *Classroom*. Duty leave and substitute teachers were not always approved, and at least two ambassadors were required to use personal time to conduct training outside of their buildings and districts. Ambassadors also noted the difficulty of being away from their students as well as their leaders' preference for them to not be out of their classrooms. Examples included:

> Ms. Keller: "I can't be a good teacher and do the science ambassador job I feel like to the extent that I could, because I feel like my first responsibility is to my students."
>
> Ms. Henson: "They just emphasized trying to not be out of the classroom."
>
> Ms. Alley: "These kids need you in the classroom. You can't leave."
>
> Ms. Worthington: "Parents don't know you're a Science Ambassador. So it's like I'm going to train these guys, and it's like where are you going."

These role conflicts and logistical challenges were specific to ambassadors who were classroom teachers. In fact, the participants who were not general education teachers cited more examples of autonomy, decision-making, and professional discretion. This suggests a possible power differential between classroom teachers and those who serve in formal instructional leadership positions. Positionality also applied to how ambassadors' colleagues viewed them, relied on them, and deferred to them. For some of the participants, that meant an elevated status. Ms. Conway stated that, "My role in my school when I became an ambassador changed somewhat, because I was more of the go-to person. I was more recognized as the science person."

Ambassadors discovered that, regardless of whether leaders stressed the importance of the GSE or expanded the capacity for implementation, their fellow teachers did not have a high

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level of self-efficacy for implementing the GSE and 3-D science instruction. Teacher readiness and resistance has been a major impediment to the GSAP.

Teacher readiness and resistance. There were 74 coded references related to teachers' lack of readiness or their resistance to implement the new Science GSE. That was a sharp contrast to the six codes about students being unprepared for the GSE. Ms. Keller observed:

> The kids are coming in and they're not really ready for the way the delivery is presented to them in fifth grade. They're not used to having to make a claim, and they're not used to the evidence part in science.

The vast majority of codes dealt with teachers' reservations about science instruction – not thinking of themselves as science teachers, having limited science content knowledge, fear of being asked questions and not knowing the answers – indicators of teachers' self-efficacy for implementing the Science GSE. All participants shared the belief that other teachers had self-perceptions of inadequate subject matter knowledge (SMK) or pedagogical content knowledge (PCK) for inquiry instruction. Those findings aligned with prior research, which showed that only 39% of elementary teachers felt well prepared to teach science (Banilower et al., 2013). Other examples were:

> Ms. Meyer: "A lot of people are intimidated by science because they're afraid they don't really know enough about the details of the content."

> Ms. Henson: "Especially in elementary school, a lot of teachers don't feel adequate to teach science. They haven't really been trained or they think they have to know all about it."

Ms. Gifford: "Teachers in my own school whom I work with are still doing a teacher led lecture to begin with and then doing a whole class instruction on one specific type of an activity."

The GSA attributed their colleagues' aversion to inquiry science instruction to various causes, such as teacher pre-service requirements that include minimal science coursework, the central focus on reading and arithmetic as foundational skills for elementary students, and professional development offerings being limited to mostly reading, writing, and math. Teacher readiness and resistance naturally overlapped with another of the six challenge areas, Limited Professional Development for the GSE, in the same way that leader readiness and problem framing coincided with professional learning. Ms. Gifford shared these thoughts:

Sometimes I think that it's not teacher's fault for not understanding the difference between GPS and GSE. Because we did have that training as a science ambassador and got to participate, not just in an hour long workshop, but to have multiple days of it…that was the fortunate thing for us in our training is that we had that extended period of time to truly see what this was going to look like, not a rushed up version, you know, a rushed job where, "Oh, I'm going to kind of talk you through most of it." I don't think talking through is the way we need to go. They actually need to participate.

A notable and related concern for ambassadors was the similarity of the old and new standards in terms of the disciplinary core ideas. For example, third graders still investigated rocks and soil, fourth graders studied light and sound as they previously did, and fifth grade students continued to learn about cells and microorganisms. Although the language and intent of the GSE was drastically different, the disciplinary core ideas were minimally changed. Spillane et al. (2006) noted that when policies press for complex change, novice implementing agents

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tend to draw surface-level connections between new policy ideas and prior experiences, which causes them to view the changes as minor variations rather than fundamental shift that require restructured mental models. Several of the participants cited this conserving nature of sensemaking as problematic, such as:

Ms. Banke: "When they saw the standards, they basically said, well, nothing's changed."

Ms. Meyer: "So many people looked at the new science standards and the common response was, well, they didn't really change."

Ms. Keller: "I see more people that just don't realize it changed."

It may require a substantial amount of effort, training, and time to persuade teachers of the deep seated changes called for by the GSE. Ms. Hudson said, "That whole idea of obtain evaluate and communicate is definitely a different mindset that a lot of teachers don't know how to do." Extensive professional development may help shift mindsets and change instructional techniques, but a sufficient segment of instructional time may also be needed for teachers to practice, refine, and master their inquiry-teaching skills. Unfortunately, the evidence showed that time was a rare commodity for elementary science ambassadors, and very little of it has been allotted for GSE training at the school-level or implementation of the GSE at the classroom level.

Time challenges. The majority of ambassadors claimed that they had an insufficient amount of time to devote to science instruction, and they expressed the same concerns about professional learning for science. There were 65 coded references to *Time*, and 14 out of 15 participants (93%) cited time challenges in general, as perceived by others, or experienced personally. Of the 14 ambassadors that noted time challenges, the majority reported diminished time for both science instruction and training. Only one of the 15 study participants did not refer to time challenges in the context of professional learning or teaching science; her only reference

to time was feeling dissuaded from spending time away from her students, which other ambassadors mentioned as well. Another GSA acknowledged that she had time to fulfill her ambassador duties only because her own children are grown and moved away. Ms. Banke said, "If I had little kids and I had to be at the ball field every night, it would be rough….now that I have the empty nest, it's like I have time to do this stuff."

The amount of time dedicated for ambassadors to conduct GSE training was negligible compared to the training they received. GSA whom were actually allowed to conduct professional learning within their own schools were given approximately 45 to 60 minutes to redeliver pertinent information about the Science GSE and 3-D teaching and learning.

Ms. Jennings: "I was given one hour one year and within these walls to do a training, and that was it."

Ms. Hudson: "They said you're gonna be working with each grade level teacher and you have forty-five minutes to teach them."

Ms. Gifford: "All she gave me was 45 minutes of planning just to talk to them, when I've got side conversations and everything else going on in there…you can't take somebody's 45-minute planning and say that's it, you're done."

Most elementary GSA essentially had an hour or less to share what they believed were key points and highlights from their four-day GSAP training, such as when Ms. Alley noted that, "When you have an hour, and you're trying to pick, oh my goodness, what is the top best stuff I need to pick? There's just so much that it's hard to redeliver in such a short period of time."

Another interesting finding was that teachers allegedly had 30 minutes per day to teach both science and social studies, so many of them chose to alternate their instruction in those two content areas by day, week, or even multi-week periods. An apparent consequence of this was

having to condense a full year's worth of science and social studies content into half of a year.

Examples included:

> Ms. Henson: "They make me split science and social studies in the same period. So I alternate teaching science and social studies which means I got a whole year of science to teach in less than half a year."

> Ms. Smithson: "Most classes get maybe 30 minutes a day that they spend on one of those subjects, and then they alternate, so they don't even get to spend a good solid chunk of time."

> Mr. Grady: "When you're only given 20 minutes a day, and so every other week you do science instead of all year, so you have 40 minutes a day."

> Ms. Meyer: "I taught writing, science and social studies. I got 90 minutes with each of my three classes. I was required to spend 50 minutes of that time doing Lucy Calkins writing program. So that left 30 minutes to teach both science and social studies, and that's just not possible to do that. You can't do it. You can't teach them in 15 minutes. So then that means you're either teaching science this week and social studies next week or one for four weeks and one for four weeks."

These findings aligned with national survey data, which found that elementary (K-5) classes typically received 20 minutes of science instruction per day compared to 88 minutes of literacy and 55 minutes of math (Trygstad, 2013). A comment from Ms. Alley highlighted the disconnect between leader framing (prioritizing the GSE) and capacity building (allotting time). According to Ms. Alley, "Even now they talk about in meetings how important science is, but when it comes down to it, they don't give you the time." One possible reason that leaders have

not taken appropriate measures is a general lack of guidance and coherence for leading GSE

implementation, distributing leadership, and supporting their ambassadors.

  Guidance and coherence. Ambassadors perceived a general lack of guidance and

coherence for leading GSE implementation and implementing the standards in their own classes.

Ms. Keller said, "I'm muddling my way through this and it's like, I feel like sometimes I'm

shooting in the dark because there's nothing out there," Ms. Hudson indicated, "There's a lot of

vagueness," and Ms. Jennings noted, "It is so very varied in the way people view this."

  Those inconsistent views and varied approaches were likely an effect of ambiguity and

diverse interpretations by ambassadors and their leaders. Although several ambassadors

complimented the GADOE Science Department personnel for their responsiveness to individual

questions and a willingness to personally assist GSA when requested, participants felt that there

was not a clear, coherent implementation message emanating from the state and extending to the

district and school levels. As Ms. Smithson explained:

> I think just some of our leaders don't fully understand how these new science standards
>
> are expected to be implemented, so I think it's hard for them to hold the teachers
>
> accountable when they don't fully understand that science should not look the same as it
>
> did.

Several other ambassadors voiced similar opinions about their leaders' being uninformed. Ms.

Alley said, "One of the biggest frustrations I also hear is that administrators don't know what

they're looking for when they walk into classes."

  The communication network between the state and the GSA also appeared to be weak at

best. For instance, the EdWeb online platform was used to create a GSA professional learning

community that offered asynchronous communication, guidance, and collaboration, but it was

not perceived by ambassadors as useful or beneficial. A total of six ambassadors stated that they

did not use it or that it was not beneficial, and none of the other participants listed it as a support

or resource. Indications of this included:

Ms. Meyer: "I just wasn't really seeing anything that was helpful to me."

Ms. Gifford: "It's not easy to access. I can never remember how I'm supposed to get

there."

Ms. Smithson: "I feel like most of what I've seen is like, hey, we've got a job opening."

A secured website was also created as a repository for GSAP training documents and

instructional resources, which only ambassadors can access based on the site's privacy settings.

Most study participants felt that the site did not achieve its objective of providing easily

accessible 3-D science lesson plans. The following were comments about the repository:

Ms. Blakeman: "I think what they wanted to do with those websites never came to

fruition. I think that the lesson plans never really came out."

Ms. Jennings: "One of the things that we found is there's such a lack of resources."

Ms. Smithson: "I would go on there and look for resources. I'm like, there's no resources.

I don't know what happened to the resources."

In the same manner leaders' priorities were intricately tied to time limitations, as previously

discussed, the problem of resources interfused the broader challenges of guidance and coherence,

capacity, and time. This again demonstrates the applicability of systems-thinking to the GSAP.

Individual school status, circumstances, and needs (e.g., turnaround schools, STEM-

certified school, low reading scores, etc.) may have resulted in conflicting priorities or competing

initiatives, both of which may have contributed to incoherence and uneven implementation.

Ms. Alley was able to contrast her previous school, where she experienced a high level of support and trust, to her new school environment:

> We are in a box at my new school, and there's no room for your own best practices. You're just told everything you have to do, how you have to do it…we have meetings every day to tell us, you know, they tell us exactly how our classroom has to be. So my classroom now is very different than what a student needs and what I know is best. At my school now, we have to make it all look organized, and in a STEM room...what is organized in the STEM room? I mean seriously, you have supplies everywhere. You have ongoing projects.

At the same time, the perceptions of ambassadors in STEM-focused settings, and the challenges they faced, were not markedly different than their counterparts in non-STEM schools.

The context for the present study was elementary-schools. Nevertheless, there was evidence to suggest that the inconsistencies in the GSAP message and operations may have resulted from differences in elementary and secondary-school mindsets. Without prompting, ambassadors distinguished between grade bands and educational levels. At least five of the participants helped guide and support district leaders that lacked experience at the elementary level. Ms. Keller said that "My science coordinator always needs my help with elementary," Ms. Gifford noted that, "She was a high school science teacher. I do know her, and I do like her, but she doesn't understand elementary science very well," and Ms. Alley stated that, "He's never even taught K through eight, never, and so he comes to me for a lot of stuff."

As several GSA pointed out, secondary science teachers are highly trained and qualified in their particular fields, which means they perceive professional learning differently. Ms. Jennings:

What science instruction looks like for me versus what it looks like for somebody who

does a STEM lab all day for fourth and fifth and somebody who teaches physical science

or whatever, sixth grade, that's what you teach. Those are very different ways of looking

at science instruction.

Ms. Spicer expressed that "When I look at our secondary schools…they're a little further along

and in the plan. But keep in mind too that your middle and high school teachers, they know their

core." Ms. Gifford added, "The person that's there now, she's more focused on middle and high

school."

The initial four-day GSAP training was divided into two-day segments. Each segment

included a general session for all ambassadors to attend, which was followed by breakout

sessions exclusively tailored for the elementary and secondary levels. Each ambassador self-

selected whether to participate in the elementary or secondary training. Using a systems-view, it

is apparent how a district leader's background influences the way they receive and interpret the

GSAP vision and message, how that interpretation interplays with district priorities and capacity,

how those factors cumulatively translate into the types and frequency of professional learning

offered. This in turn limits or expands individual and collective capacity for implementation by

principals and elementary GSA. Mr. Grady suggested that, "science [PL], it's harder…that's a

different beast than any other, especially in elementary school." If that is indeed the case,

district-level science leaders that were formerly middle or high school teachers may not

understand the need for extensive science professional learning that addresses the subject matter

knowledge and pedagogical content knowledge of elementary school teachers who teach science.

The interconnectedness of sensemaking, positionality, and professional development

programming is perhaps one reason why professional learning for the new Science GSE has been limited or non-existent.

Professional learning constrained. Participants applied the concept of professional learning challenges to themselves and other teachers, and most of the study participants reported that they have conducted minimal or no professional learning for Science GSE implementation. Ms. Jennings said,

> I'll be honest with you. I think largely not much has changed. I think there's very few teachers that have changed because there's no training taking place to show them what we mean by that and how to do it.

"Teachers can't do what they're not taught to do. They can't push out to their students what's never been pushed out to them," Ms. Meyer explained.

In the same way that time constraints have limited the scope of science instruction and training, the underutilization of ambassadors precluded professional learning for the GSE. The unrealized potential of ambassadors emerged as a central challenge and integrative theme, but there were several challenges associated with professional learning that did not relate to the underutilization of ambassadors. For instance, two ambassadors reported that professional learning for inquiry science was perceived as playful and that teachers did not comprehend the value of the inquiry approach. This was Mr. Grady's experience:

> Some of them took it as like, oh, we just played. I had fun as an adult with a fizzy cap and a film canister and it popping and we all laugh and try different things. That's not science, that's just goofing off.

One participant explained that she was very excited to have worked in partnership with a fellow GSA to plan and schedule a GSE training workshop for a neighboring RESA, but it was

cancelled at the last minute due to lack of registrants. She lamented about the lack of interest and enthusiasm for science professional learning, which could be a manifestation of elementary teachers' beliefs and attitudes about science instruction. A systems-view of professional learning includes and connects teachers' pre-service class requirements with their subject matter (science) knowledge as well as their beliefs and attitudes about teaching science (Kazempour, 2009). Two participants cited the limited experiences of pre-service teachers as problematic, which helps conceptualize professional learning as a macro and micro system. According to Ms. Alley:

> At the elementary level, they may not even know science. I mean honestly they only had
> to have one or two classes, maybe if that, to get their teaching certificate. So I'm having
> to back up all the way to content.

Similarly, Ms. Gifford claimed that science is not a priority, even on a college level. Her belief was partly based on several new teachers in her school building, all recent graduates, who were not adequately prepared to deliver effective inquiry instruction. Considering elementary teachers' lack of pre-service science coursework, Trygstad (2013) found it somewhat surprising that up to 39% of those teachers felt well prepared. The apparent trickledown effect of inadequate pre-service science training supports the notion that science professional learning challenges may be deep-rooted and complex. The problem of insufficient pre-service science requisites may be compounded by the fact that, once those new elementary teachers advance into the field, they may never receive the formal training that their universities ideally should have provided. Their future science professional development may depend on their personal inclinations.

Several ambassadors reported scant opportunities for their own professional growth. They credited their personal initiative to read books, learn online, and attend conferences. For

example, Ms. Blakeman noted that "I didn't get it from the state. I got it from supplemental, from my own reading."

Conferences were a primary means by which ambassadors received science training, networked, and shared information with others. There were 21 references to professional conferences from nine of the study participants, most of which had positive connotations. Ms. Meyer said, "I've gotten so much out of every conference I've been to. It's just been a wealth of knowledge and resources."

Unfortunately, the privilege to attend or present at the annual Georgia Science Teachers Association (GSTA) Conference, STEM Forums, National Science Teachers Association (NSTA) Conference, and other similar events was not extended to all ambassadors. Ms. Smithson said, "I have not had the opportunity to go to those kinds of things," while Ms. Keller said, "I was asked to speak at the STEM conference. I couldn't go. So things like that happen, like where I'm asked to speak and I'm not approved. That's a challenge."

Ambassadors have been restrained in various ways from leveraging and sharing their knowledge, skills, and enthusiasm for inquiry science instruction and 3-Dimensional teaching and learning. When principals denied ambassadors' requests to attend professional conferences or granted them only 30-45 minutes to conduct professional learning, they not only squandered the passion and potential of their elementary GSA, they also diminished professional learning for the new science standards. Leaders' decisions about professional learning invariably derive from their past experiences and current understandings about professional development and adult learning (e.g., what high quality professional learning should look like). An important deduction based on the data was that the connection between the distributed-leadership function and professional learning appears to be particularly potent. Ms. Meyer noted, "They took my

presentation and pushed it out to everybody in the county, but I think probably nine out of 10

never watched it. It never really got redelivered."

Inherent in Ms. Meyer's statement is that, when her presentation was disseminated, it was

not framed as mandatory or critically important. This is evident in her belief that very few

people actually watched it. It stands to reason why Ms. Meyer's administrators would opt for the

most expedient means of GSE training, but their decision to share her conference presentation

slideshow did not align with her knowledge and skill as a science ambassador, much less the

vision of the GSAP. This scenario demonstrates the mediating systemic factors such as

positionality, efficiency/expediency, time challenges, and problem-framing by leaders.

Although research suggests that distributed leadership is a necessary means to achieve

organizational goals, it is obvious that too often leaders have reserved their authority to delegate,

and they have wielded their power in ways that marginalized elementary ambassadors. This

supports Kwakman's (2003) findings that great discrepancies exist between theory and practice

in opportunities for professional development at the workplace. The loss of real potential

appears to be real and pervasive.

Unrealized leadership potential. Most elementary science ambassadors have not been

given considerable formal leadership opportunities to help their colleagues understand and

implement the new standards. Their enacted instructional leadership has mainly been informal

guidance and support. There were 57 codes from 13 participants that fit within the category *Not*

Utilized. Some of those codes pertained to unused resources and science equipment, but many of

the statements were about ambassadors not being as useful or productive as they expected or

hoped to be. For example, Ms. Smithson said, **"**I don't think I was utilized as well as I could

have been utilized as a science ambassador," Ms. Blakeman lamented, "It's a shame they didn't

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use us more," and Ms. Worthington explained, "I did not do any training but I always assume that they didn't ask me because they have something else planned." This statement by Ms. Griffeth shows how a lack of guidance resulted in her inactivity as a GSA:

> I do feel like I could have done more, but I just didn't know how to go about that. I mean I didn't want to reach out to every school in the county and be like, "Hey do you want me to come?"

The underutilization of ambassadors was not always the result of leaders simply not having a clear and purposeful vision for using the GSA. Sometimes leaders refused or blocked opportunities for their ambassadors to lead, teach, and learn without citing a valid reason for doing so. Examples of this include:

> Ms. Henson: "Our county curriculum director told me that the ambassadors had called and wanted me to go to other places to do training, and she told them no, they weren't going to let me do that."

> Ms. Worthington: "I stayed all summer. I did the research. I wrote a proposal…and we're ready, we're on board, what do you mean, No?"

> Ms. Meyer: "I could help them fit science into their day if I had the opportunity to talk to them about it, but that doesn't happen."

Ambassadors whom were never given opportunities to train their colleagues expressed disillusionment and frustration. They said:

> Ms. Henson: "I thought why in the world did you send me to that training? You paid for a sub for 4 days for me, and then nobody was interested."

> Mr. Grady: "I'm more of a full time teacher than an ambassador. It may have opened the doors, but I don't use that role very often."

Other leaders' interpretations about how science ambassadors could or should be utilized likely accounted for the types and levels of distributed leadership, allocated resources, and support that the GSA experienced. The findings pointed to a possible disconnect between ambassadors' perceptions about their roles and responsibilities as a GSA compared to their leaders' perceptions about how ambassadors should carry out their implementation work.

Enacted leadership and trust. All but two of the elementary science ambassadors enacted formal leadership on at least one occasion. Formal leadership included any instance of professional learning or curriculum development conducted by a GSA, such as GSE teacher workshops, presenting at science conferences, creating 3-D Science instructional resources, being observed by other teachers, and collaborating with district leaders to design or revise science curricula. There were 81 coded segments of data that referenced *formal leadership*, considerably more than the 37 codes related to *trust*, and there was an interesting parallel between the two sets of codes. The frequency of trust codes appeared to be positively associated with the frequency of references for formal leadership. In fact, there were two participants without any coded references for formal leadership, and those same two ambassadors had zero codes for trust. Data that were coded as trust typically referenced leaders or teachers placing trust in the elementary GSA. For example, a majority of the participants claimed that they were recommended or highly recommended for the program by either their principal or district leadership, which suggested an initial baseline sense of trust between leader and ambassador. Science ambassadors that perceived higher levels of trust from their leaders tended to have elevated formal leadership. On the other hand, relatively few or no trust codes was an indication that ambassadors perceived that their leaders did not trust them. Conclusions could not be drawn about whether or not leaders actually trusted ambassadors, especially considering the intricacies

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and nuances of leadership. However, the advice and support that elementary ambassadors have provided to their district science leaders underscores the role of organizational trust and blurs the lines between formal and informal leadership.

There were 15 codes from seven participants that related to *Helping Leaders*. As previously discussed, some of that assistance was attributable to district leaders' unfamiliarity with elementary science content and pedagogical practices, but that was not always the case. Seven participants cited one or more instances of guiding their leaders, designing curricula, developing instructional pacing guides, and serving on evaluation teams. They indicated:

Ms. Worthington: "My old principal she came and she said, "Okay, what do you think we should do?""

Ms. Henson: "She just didn't have the background and the experience that I had about it. She would turn to me and say, 'Is that right?'"

Ms. Meyer: "I go to the board office in the summers and sometimes during the school year and meet with the curriculum director and help with laying out the pacing guide and the curriculum map for science for the year."

Ms. Alley: "This summer I sat with the science coach, the instructional coach for the district, and we had to rewrite the frameworks to match, to make sure it matched the new standards."

The higher frequency of codes for formal leadership did not automatically equate to intensity or importance. Although a majority of the participants conducted some type of formal leadership, it was most often limited in scope and duration. For instance, a single 45-minute training session during each team's planning period was an example of enacted formal leadership, and the GSA may have been entrusted to plan and implement the training, but that

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formal leadership was not always perceived as beneficial. Most ambassadors felt that their

informal acts of leadership were more impactful than their formal contributions. Two exceptions

to this were the Teacher on Special Assignment (TSA) and the school-based science coach,

whose official roles allowed for substantial opportunities for formal leadership. Although both

of those individuals reported helping teachers informally, their structured trainings impacted

larger groups of teachers on a more consistent basis compared to their informal leadership

actions or other ambassadors' formal leadership actions. Interestingly though, a recent

restructuring of district leadership in the TSA's system has decreased the frequency of her formal

training interactions at the school-level, so she has resorted to more informal support of

individual teachers. These circumstances demonstrate how the work of a GSA is one of many

interdependent subsystems.

All 15 participants actively led the implementation of the Science GSE through informal

means. There were 56 codes for *informal leadership* as opposed to 81 codes for formal

leadership. Again, the lower frequency indicated leadership and on a smaller scale (e.g., GSA-

to-individual or GSA-to-team) but did not necessarily signify a lesser degree of importance.

Ambassadors informed others about the new standard, developed curriculum resources, shared

information and ideas on social media, recommended essential readings, and even taught their

colleagues content and instructional strategies (e.g., questioning techniques). Ms. Elliott shared,

"I kind of work behind the scenes with a lot of teachers" and Ms. Alley indicated that, "There's

been a lot more of that…where people just reach out and say, 'Please help me, I don't know what

to do.' So I think that happens way more than the actual training does, you know, the formal

training." Ms. Gifford also claimed to have helped more people through informal interactions:

I ended up helping more people that way and also not even within my school, or not even

in within my county. I get teachers from around the state that will also say, "Hey, can

you help me with an idea or a lesson plan?"

As with formal leadership, heightened levels of perceived trust between ambassadors and their

colleagues were associated with greater frequencies of informal leadership.

Elementary ambassadors made the best of their unique situations, and they capitalized on

their informal leadership roles. However, most of them felt strongly about the need for

widespread, formal, high-quality professional development for implementing the Science GSE,

an inclination based on their personal values, beliefs, and experiences. Ms. Meyer claimed that

the GSAP changed her life and career, and it set her on a path that she might not otherwise have

experienced:

I just wish that it was something that was being shared. I would love for it to be

redelivered. I would love to be able to share all this with everybody else in my county

and for them to get to know what I know.

That conviction was reflected in every other study participant's words, tone, posture, attitude,

and energy. For example, Ms. Alley stated, "Imagine if every teacher was actually able to do the

science standards like we learned them. It would be a really good thing. It would really be

awesome."

Secondary source analysis and triangulation of data. GSAP training documents and

notes served as beneficial triangulation points for the interview data and findings. Merriam

(2009) claimed that, despite certain limitations, documents about a particular subject are an

excellent source of data, perhaps even better than observations or interviews. Archival

documents and digital artifacts were coded using a combination of holistic, structural, and

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concept coding strategies, during and after which the results were analyzed and triangulated with the interview data and researcher's perspective.

The presentation slides and notes from the first two-day training session provided points of triangulation for the interview data and findings. Day one of training was framed as an introduction to literature on best practices, and the primary source of the content and research references was *A Framework for K-12 Science Instruction* (National Research Council, 2012). The tenth presentation slide provided a link for a free downloadable version of the book, but that was the first mention of the resource. The *Framework* was new to me and many others in the audience, which meant some of the information being presented seemed foreign and out of context. Ms. Meyer asked, "They kept talking about the framework, the framework, the framework, and I'm, what framework, what are they talking about? I had never heard of the framework book before, ever."

The Framework was a primary source of the participants' self-directed professional learning. Additionally, each GSAP trainee received a printed copy of a crosswalk booklet (Georgia Department of Education, 2016a), which offered a side-by-side comparison of the prior Georgia Performance Standards and the new Georgia Standards of Excellence for Science. Training slides also included information about the altered language of the new standards and the rationale for those changes, which was based on the *Framework*. During the first day of training, there was a brief discussion and an explanatory presentation slide about why the term "practices" is used instead of "skills," the false notion of a single "scientific method," and the lack of a common understanding of what "inquiry" means. The interplay of language, constructivism, and sensemaking were also evident in the day four presentation, although the terms constructivism

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and sensemaking were not used. As shown in Figure 4, presentation slides from day four

reiterated the issue of speaking the same language and defining terms differently.

Slide 76

Slide 77

Figure 4. GSAP training presentation slides addressing language and sensemaking.

This component of the training modeled constructivist learning about language and educational vernacular, but it did not explicitly address or convey the critical role of language in interpretation and decision making. If the trainers mentioned the significance of language in interpreting and implementing the GSE, they did not emphasize the need for ambassadors to highlight the point during their own professional development.
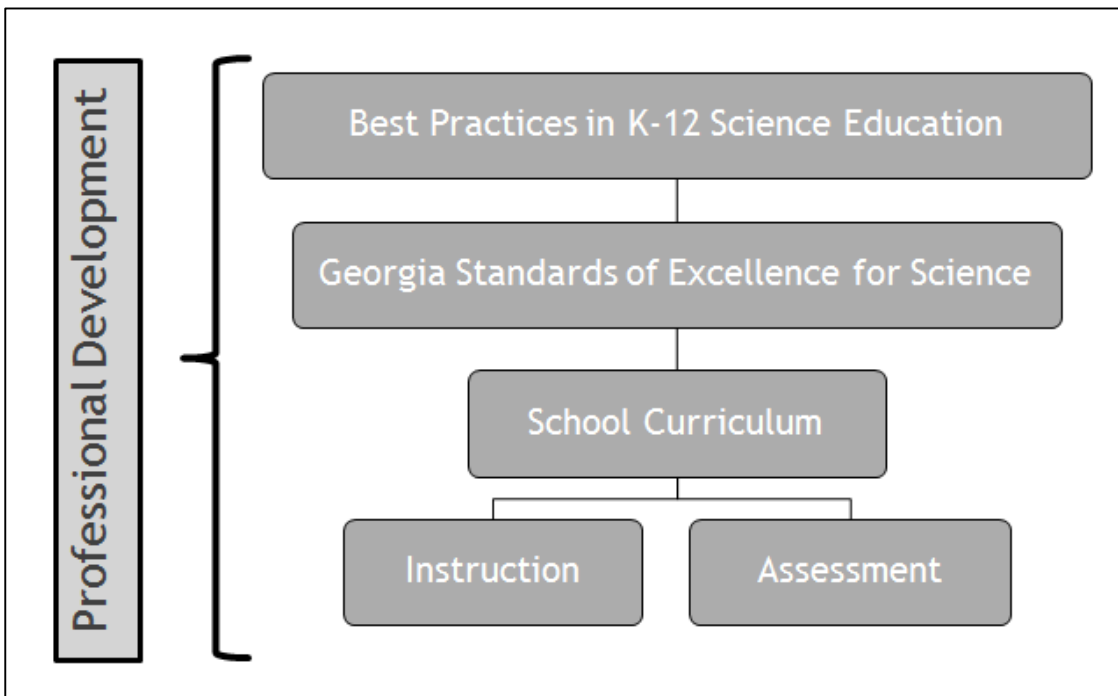
Figure 5. Levels of professional development as presented at GSAP training.

There were only five references to *Professional Development* in the first day's presentation, and only three of those were substantive; the other two instances included an introductory slide titled "Overview of Professional Development" and the description of a cited resource as a toolkit for professional development. Two similar presentation slides depicted the levels of professional development according to the GADOE, which are shown in Figure 5, and a third slide stated that school systems would "provide adequate professional development to

enhance understanding" (see Appendix I). There were no references to adult learning theory, and no specific guidelines or advice were given for how to structure or implement GSE professional learning.

At one point during the first day of training, when ambassadors were directed to brainstorm a list of potential training activities, they were told, "Remember! This is about you planning your training session for your teachers" (see Appendix I). Although no specific parameters or guidelines were offered for how to conduct district and school level trainings, there was a presentation slide that prompted a discussion of the redelivery action plan and a blank action plan was provided (see Appendix J). There were no instances of the words *professional development* or *professional learning* in the day-two presentation, which focused on the impact of instruction. These data from the document analysis help validate the findings about professional learning. Another slide stated, "Don't be quick to answer. You are not the solution. You are the change agent. 'I don't know, but I'll find out is a good answer.'" A careful analysis of those instructions reveals their contradictory nature. The impetus for finding or developing solutions still falls on the ambassadors, but where and how they are expected to do so was not addressed. These data points triangulated well with the following claim by Ms. Meyer:

> The trainer kept saying this is not a train the trainer model, it's not a train the trainer model, and I don't know if that was a great idea. I guess they were trying to show us how to teach students by treating us like students, by not giving us any answers to anything. But in the limited time that we had, I feel like maybe we should have had a few more answers given to us and a little bit more, a little bit of the train the trainer. Because instead of, when you would ask a question, she just would never answer your question.

And if you're not clear on something and yet you're expected to go and try to redeliver it

to other adults, I need you to answer my question.

Ms. Meyer's perceptions of uncertainty, lack of guidance, time limitations, and the frustration of

experiencing a new approach to teaching and learning were also an index of how other

elementary teachers might feel during GSA-led professional development.

The issue of time constraints and positionality was also noticeable in the training

documents. A presentation slide from day two, which was titled *Discussion of Redelivery Action*

Plan, directed the GSA to determine their goal for redelivery, determine the time allotted, and

develop a timeline of activities. This assumed that ambassadors were sufficiently knowledgeable

about planning and implementing formal professional development to be able to develop a plan

and timeline. It also predicted that the GSA would have enough authority, or at least meaningful

relationships with other leaders in positions of authority, to be able to decide on an

implementation process and allot a reasonable amount of time for training. That certainly may

have been the case for ambassadors that served as curriculum directors, but the data showed that

most of those individuals received the middle and high school version of the GSAP training.

Significantly, a presentation bullet point shared with the elementary group during the first day

read, "Recommendations: Framework: pages 298-309." The reference was to a set of 13

recommendations within the *Framework* that provide detailed guidance for developing new

science standards, and it was significant to the case study for several reasons. The designated

range of pages began with Recommendation 11, which stated that, "Any assumptions about the

resources, time, and teacher expertise needed for students to achieve particular standards should

be made explicit." (p.305). Even more ironic was a line in the very next paragraph that stated,

"For example, in order to meet the goals for science education in the elementary grades, more

time may need to be devoted to science than is currently allocated." (p.305). This is a significant

finding in the document analysis because it demonstrates how the issues of time, resources, and

expertise were indistinctly addressed. It also validated the claims of the study participants that

time-challenges were a major barrier. A bullet point reference to such a key feature of standards

development and implementation could be interpreted as a tacit signal from the state department

that time, resources, and teacher-training are critical considerations. The analysis revealed

similar implicit messages about priorities and evaluation, which were evident in training

documents for administrators.

The GADOE sponsored a one-day seminar in May 2017, the *Evidence-Based*

Instructional Practices for Supporting the Science Georgia Standards of Excellence, for

administrators to learn about the Science GSE and 3-Dimensional Science Teaching and

Learning. The official itinerary and my anecdotal notes from that day triangulated two major

findings of the present study. My notes (see Appendix F) revealed my frame of mind and

cognitive actions that day, and I remarked how timely, interesting, and ironic it was that I was

reading *Implementing State Standards for Science Education: What District Policy Makers Make*

of the Hoopla (Spillane & Callahan, 2000) at the time. I documented that the trainer was using

the same verbiage that I had underlined and highlighted in my research articles, such as

"conceptualizing" and "construct understanding." When he asked the audience "What is your

vision for science education?" I annotated how the question related to constructivist learning

theory. I noted that while administrators were listening to the lecture about 3-D Science, an

assumption was being made that they had sufficient background knowledge or expertise to make

sense of the information presented. The learning was completely out of context for them, and I

wondered about the participants' impressions of the training. Many of the administrators, even

those at my own table, were checking emails, texting, and having sidebar conversation throughout the lesson, indications that they were not paying attention. The audience engaged with a phenomenon, a hands-on activity that helped frame the content of the lecture, but I suspected that most of the leaders in the room did not fully grasp or appreciate the purpose of the lesson. The trainers were modeling the use of an anchoring phenomenon and the science and engineering practices to demonstrate an exemplary science lesson and the merits of constructivist-based science education reform.

I concluded, based on the interview experiences, document analysis, and reflexive journaling, that the one-day leadership training was highly impactful and transformative for me probably because I had been previously trained and was an experienced GSA. I had been actively working as an ambassador for one full year and my prior background was science education. Therefore, I had foundational knowledge and a context for the training, which most of the administrators there likely did not. As I surveyed the room, I imagined what the other participants' backgrounds were – literacy, math, band, special education, or science? I was curious about whether their understandings of the GSE implementation process and desired outcomes would be significantly altered by less than six hours of training. Approximately one and a half years later, after analyzing interview data and reviewing GSAP documents, my experiences and curiosities from May 2017 gained meaning and consequence. My thirteenth interview helped answer the question about leaders' comprehension of the GSE and 3-D science. Ms. Gifford said:

> I think this year I finally, I'm starting to figure it out...me, a person who teaches this, and a person who's taken the training in it, and it's taken me almost three years to finally like really, really, maybe truly grasp what it needs to look like.

Those sentiments were echoed by other study participants as well, and it begged the question of whether and how non-GSA building and district leaders could ever hope to implement the GSE without distributing leadership and support to their science ambassadors.

During the course of the interviews, several participants opined that principals did not understand what GSE-based science instruction is supposed look like. Another major finding was that literacy and math were a dominant priority that has subverted the GSAP vision. Both of those findings were reminiscent in the official itinerary for the administrator training day. According to the document, one full hour was devoted to answering the question, "How Does this Approach to Teaching and Learning Engage Students in Reading and Writing in Science?" In terms of official training for school and district administrators (outside of what the GSA could have provided to them), the leaders received a 45-minute overview of the GSE and 3-Dimensional Learning, they engaged in a one-hour 3-D science lesson, they spent an hour learning about the literacy connection to 3-D science, and they discussed an observation protocol for an hour. I recorded in my notes that administrators were told about Georgia Science Ambassadors being in the process of developing curriculum maps and assessments, but that was the extent of discussion about the GSAP and its ambassadors. These observations support science ambassadors' claims that many principals do not comprehend the purpose of the GSAP or how to properly use their ambassadors. The documents also provide evidence of the major emphasis placed on literacy instruction.

Discussion

Summary of findings. The goal of the case study was to generate an increased understanding of the GSAP based upon the detailed analysis of ambassadors' personal accounts and testimonies. The GSAP, which was instituted as the primary means for implementing the

Georgia Standards of Excellence for Science, had not been thoroughly explored, characterized, or evaluated until the present study. The case study was designed to examine the perceptions and experiences of the GSA about distributed instructional leadership and support for accomplishing the GSAP mission. More specifically, the study used a systems-view to investigate how distributed instructional leadership and support have influenced their ability to roll out the new GSE for Science. An empirical investigation of ambassadors' perceptions could potentially delineate the program's substantive qualities and functionality, inform policymakers and leaders about how to support or improve the GSAP, and directly influence the ongoing work of Georgia Science Ambassadors. The results exceeded my expectation for accomplishing that goal.

The sample of 15 science ambassadors provided sufficient data to identify recurring patterns and common themes (Fusch & Ness, 2015; Guest, Bunce, & Johnson, 2006; Hagaman & Wutich, 2017). The findings revealed that some progress has been made by the GSAP in isolated areas, but there is still much work to be done. The relative success or failure of ambassadors' efforts may have depended on their ability to interact and negotiate within a network of dynamic systems (Burch, 2007). More importantly, their leaders' understanding of systems thinking, systems drivers, and systems change may have been a key determinant of ambassadors' abilities, efforts, interactions, and limitations.

The elementary-level science ambassadors identified challenges and obstacles that have impeded their effectiveness, and they pointed out specific practices and supports that might facilitate GSE implementation (see Appendix K). Most ambassadors felt confident and competent to help lead GSE implementation, but they have received limited opportunities and support for doing so. A primary challenge to ambassadors' work was that GSE implementation

was not prioritized or emphasized by leaders. One possible reason for this may be that leaders have received minimal training about the GSE for Science and how to guide and support their implementation.

Even in cases where leadership and support were distributed to ambassadors, it was mediated by other variables such as time constraints, capacity, and a lack of guidance, coherence, and teacher readiness for inquiry science instruction. All of these factors have resulted in sparse opportunities for teachers and leaders to receive professional development from ambassadors. Regardless of whether and how leadership and support were distributed to the GSA, they felt somewhat repressed and largely underutilized. The vision of the GSAP was for elementary-level science ambassadors to formally lead the implementation of their state's new science standards. Despite the fact that they have had limited opportunities and support for achieving that vision, they have strived as informal leaders to promote the Science GSE, model inquiry-instruction and constructivist-learning, and support others to integrate 3-Dimensional Science. By their own claims, they intend to continue that work indefinitely.

Theoretical implications. The study suggests a useful theoretical framework, a combination of distributed instructional leadership theory with systems theory, for conducting educational policy and leadership research. The findings neither challenge nor support the basic assumptions of distributed-leadership theory, but they do raise the question of how the relative distribution of instructional-leadership relates to educational policy commitments. Distributing leadership and support within a complex policy environment does not necessarily ensure successful implementation. There is a pressing need for more research that connects distributed instructional leadership practices to policy implementation, particularly where it concerns the adoption of reform-based learning standards. Although several scholars have made theoretical

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connections between distributed leadership theory and various systems aspects of leadership (Spillane & Orlina, 2005; de Lima, 2008; Yuen, Chen, & Ng, 2016), many leaders are not attentive to the systems component of distributed leadership. In discussing the entailments of a distributed perspective, Spillane and Orlina (2005) pointed out that leadership practices must be understood as interactions among leaders, followers, and situations; occurring in a particular time and place; part of systems of practice or activity systems; enabled or constrained by social structures that exist at various levels of the system. Similarly, de Lima (2008) demonstrated the use of a social network approach to understand distributed leadership systems, and he described leadership as "activities that actors in a social system design to influence other actors in that system" (p. 165). Finally, Yuen, Chen, and Ng (2016) studied distributed leadership in terms of interrelated activity systems, where the term "activity" referred to leadership actions within a particular context. If leaders do not understand systems as a theoretical underpinning of distributed instructional leadership, the practical implications will be lost on them. Immanuel Kant observed that, "Theory without practice is merely intellectual play." The GSAP case study implicates the need for a theory-to-practice framework for distributed instructional leadership, which might translate the theoretical assumptions and assertions into practical applications.

Practical implications. The findings mirrored some of the functional challenges and "lessons learned" from research on NGSS implementation. This suggests some practical implications for leaders at every educational level, including elementary science ambassadors who are still in the field. The evidence is clear that elementary ambassadors are indeed poised to implement the GSE, and they are eagerly waiting for the opportunity to do so. Each of the 15 study participants expressed a high level of passion for the GSAP cause and a genuine desire to see it actualized. Their training and experience have given them confidence to act as formal and

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informal instructional leaders, but they perceived disparate levels of distributed leadership and support. Lee, Hallinger, and Walker (2012) demonstrated the importance of leaders acting intentionally to distribute instructional leadership responsibilities, and the present study reinforced that finding. One recommendation based on the findings is to support principals and other leaders with professional development and mentoring. The intricacies of leadership and policy are no less perplexing than the complex, multi-level, interdependent systems through which they manifest. Leaders must be taught to recognize and consider their own interactions within and across dynamic systems, including their everyday practices and decisions.

The GSAP vision may not be realized unless districts and principals are willing to distribute leadership responsibilities and provide various types of support to their ambassadors. A logical first step in that process is for leaders to assess their dispositions, inclinations, and readiness for authentic distributed leadership (Georgia Leadership Institute for School Improvement, 2015). The adage that "leaders make time for what is important" resonates with the study's findings and the GSAP cause. Leaders should allow and support the elementary-level GSA to attend and present at professional conferences, workshops, and similar events. At the same time, science ambassadors must be willing to submit conference proposals, conduct presentations, and host professional learning workshops. The GADOE stands to benefit from developing more opportunities for ambassadors to communicate and work collaboratively.

The hope is that the number of ambassadors in the advice-seeking network will grow and ambassadors' centrality in the network will increase over time (Wang & Hendrick, 2017). The findings of the present study suggest that, in order for that to happen, the GADOE and individual school districts must begin utilizing elementary science ambassadors to ramp-up science professional learning for GSE implementation. However, professional development for teachers,

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leaders, and ambassadors is only one part of the equation. State, district, and building leaders must intentionally emphasize the significance of the new science standards and give inquiry science instruction equal footing with literacy and math. As one ambassador said, leaders must give science a slice of the pie.

Another practical implication for future comparable policy initiatives is the selection criteria for primary implementing agents, who in this case were science ambassadors. The evidence showed that ambassadors' positionality (i.e. classroom teachers versus formal instructional leadership roles) related to their perceived sense of efficacy, decision-making power, and enacted formal leadership. Across the board, classroom teachers had less autonomy and authority to make instructional leadership decisions such as determining the scope, frequency, and duration of science professional learning. Selection criteria should therefore consider the extent to which a candidate's current role will afford discretion, flexibility, and authority for shared instructional leadership. This is not to say that classroom teachers should be excluded from ambassador-like positions. However, it is critical that leaders recognize the dual role of classroom teachers who serve as implementing agents, acknowledge the ambassador role as distinguished and vitally important, and genuinely share leadership responsibilities with those individuals.

Policy implications. During the writing of this report, the National Academies of Sciences, Engineering, and Medicine conducted a *Workshop on NGSS District Implementation* (2019). One of the goals of the workshop was to explore strategies for supporting districts' efforts and capacity to implement the NGSS and similar reform-based standards (National Academies of Sciences, Engineering, and Medicine, 2019). The GSAP case study has accomplished this by generating very specific data to inform the policy learning process.

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Distribution of leadership and support may be a potential means for accomplishing policy goals, but the data showed that leadership and support may be inadvertently or intentionally constrained instead of distributed. The GSA study participants also offered specific recommendations, based on their personal experiences and perspectives, about how to improve the GSAP and achieve its policy pursuits (see Appendix K). The findings offer insight and suggestions for the use of distributed instructional leadership and support in future educational policy endeavors. State lawmakers, boards of education, local educational authorities, and building administrators can respond accordingly to facilitate continuous and improved implementation efforts for the GSE, NGSS, and other reform-based standards initiatives. They can leverage policy tools, such as incentives or mandates, to frame the GSE for Science as new and essential. More importantly, leaders at all levels could recognize and legitimize the critical role of elementary Georgia Science Ambassadors.

       Suggestions for future inquiry. The findings and limitations of the study suggest areas of interests for educational leadership and policy implementation research. Three key areas emerged as promising opportunities that are timely, favorable, and vitally needed. Based on the elementary GSA voices in the field, future studies should focus on (a) professional development related to the GSE and 3-D Science, which targets both leaders and teachers; (b) the predominance of literacy and math instructional foci and its consequences for science and social studies instruction; and (c) the causes and effects of time constraints on teachers' instructional priorities and practices. I recommend a comparable qualitative case study, which includes secondary-level science ambassadors' perceptions and experiences, as a logical next step to extend the scope of the current study and further elucidate the GSAP. The use of a survey instrument within a quantitative or mixed-method design might result in a larger sample and data

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that can be disaggregated and generalized. Survey research that targets the full population of current and former science ambassadors could elicit data that differentiates ambassadors' perceptions and experiences by educational level (e.g., primary versus intermediate grades, elementary versus secondary schools), content area (e.g., life science versus physical science), tenure/experience, and other similar factors.

There is an abiding interest to learn more about the relationship between distributed leadership and the (under)utilization of elementary-level science ambassadors. It may be useful to discover how administrators' perceptions and experiences align with those of ambassadors and how that relative alignment influences the distribution of leadership and support. Since trust and learning were two important components of ambassadors' formal and informal leadership activities, I suggest that future studies of the GSE use a theoretical framework of organizational trust, social capital theory, learning theory, or some combination of the three. It might be useful to discover how organizational learning mechanisms and organizational citizenship behaviors relate to the GSAP. In light of the study participants' recommendations for higher levels of structured collaboration amongst ambassadors, an encouraging avenue for future research is communities of practice and architectures of learning for science GSE implementation.

The elementary GSA are passionate about their charge and feel capable to achieve it. Unfortunately, some leaders either do not understand the purpose of the GSAP or they simply choose not to leverage the talents and competencies of their GSA to help implement the Georgia Standards of Excellence for Science. It was not within the scope of this study to determine causality or the effects of leadership and policy decisions, but the GADOE and other state departments of education can certainly benefit from learning the ground-truth status of GSE implementation. We now have a more accurate understanding of the status quo, and we have

been offered clear and consistent advice from science ambassadors on the front lines. The

impetus to carry the work forward is now on educational leaders, policymakers, and science

education researchers.

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APPENDICES

APPENDIX A

TIMELINE OF RESEARCHER'S INVOLVEMENT IN THE SCIENCE AMBASSADOR

PROGRAM

April 2015	Completed Georgia State University Leadership Endorsement Program
April 2016	Applied to participate in the Georgia Science Ambassadors Program
May 2016	Selected to be one of four elementary science ambassadors in my district
June 2016	Enrolled in Georgia State University's Ed.D. Leadership Program
June 2016	Initial two-day training for Georgia Science Ambassadors Program
July 2016	Transitioned to new role as K-5 Science Instructional Content Coach
September 2016	GSU Educational Policy Analysis Class
October 2016	Final two-day training of Georgia Science Ambassadors Program
May 2017	Training: Evidence-Based Instructional Practices for Supporting the Science Georgia Standards of Excellence
September 2018	Launched Case Study of Georgia Science Ambassador Program

FUNNELING APPROACH TO ANALYZE THE GEORGIA SCIENCE

AMBASSADORS PROGRAM

Perceptions and Experiences of Elementary-Level Georgia Science Ambassadors

Data Analysis

Interpretivist-Constructivist Epistemology

Distributed-Instructional Leadership

Systems Theory

Data Analysis

Increased Understanding of the Georgia Science Ambassadors Program
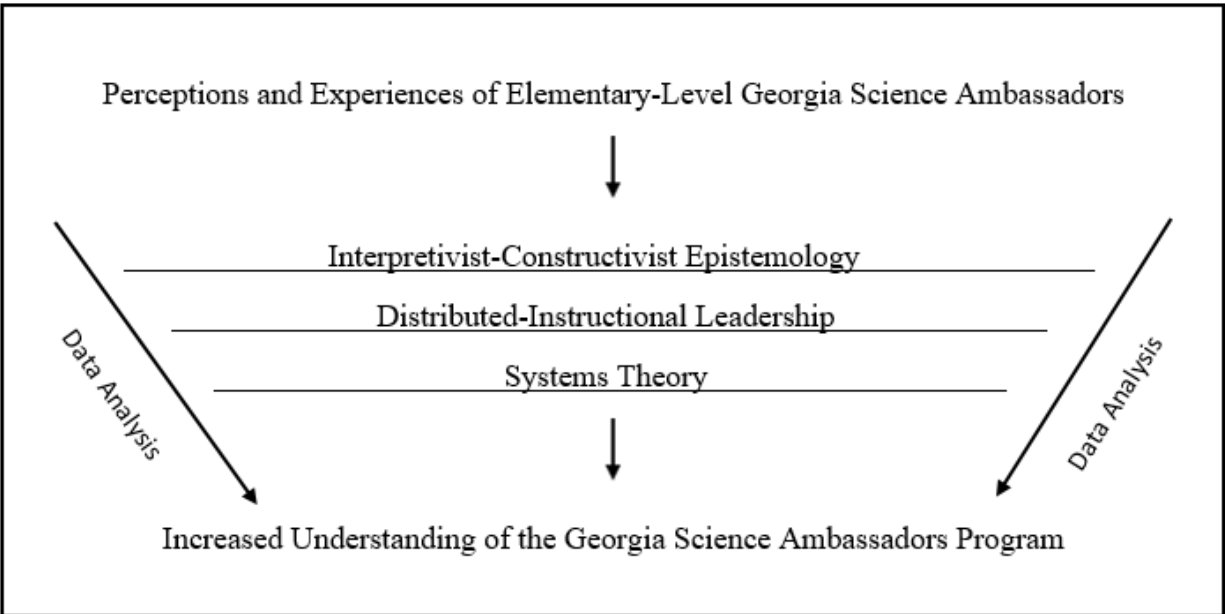
APPENDIX C

REGIONAL EDUCATIONAL SERVICE AGENCY (RESA) MAP OF GEORGIA

Picture Retrieved from:

https://www.georgiastandards.org/Learning/Pages/ETC-RESA/RESA.aspx

INFORMED CONSENT FORM

Georgia State University
Department of Educational Policy Studies
Informed Consent Form

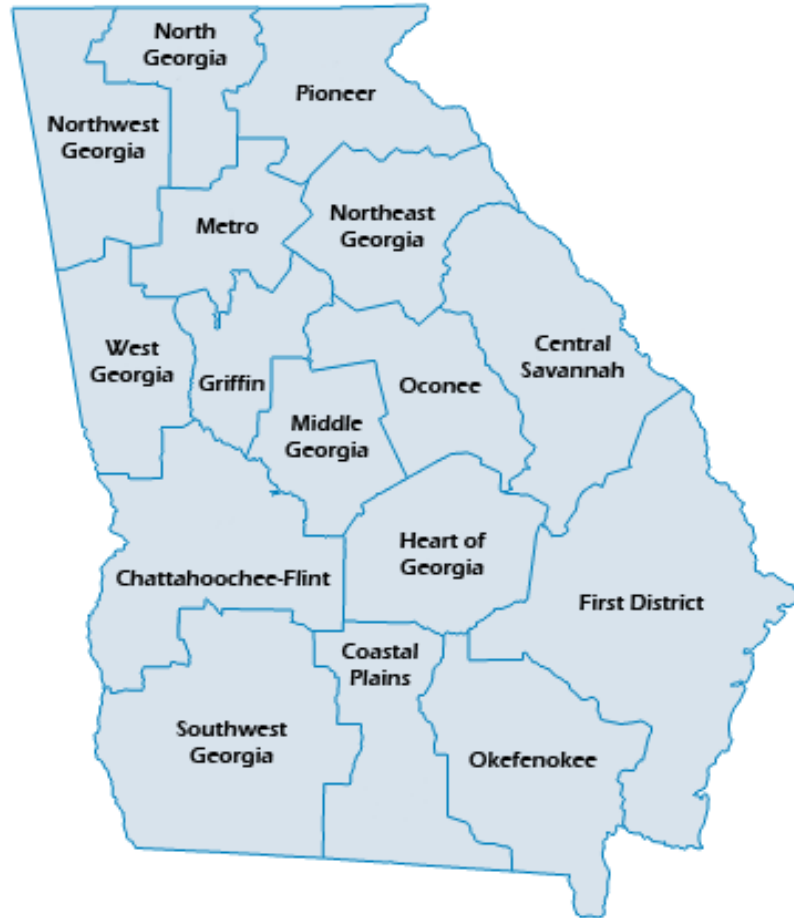Title: The Perceptions and Experiences of Elementary Georgia Science Ambassadors: What Educational Leaders and Policymakers Need to Know

Principal Investigator: Sheryl Cowart Moss, Ph.D.
Student Principal Investigator: Charles Harper

Purpose
The purpose of the study is to investigate the perceptions and experiences of elementary-level Georgia Science Ambassadors (GSA) about the distribution of leadership and support they have received for implementing the new Georgia Standards of Excellence (GSE) for Science. You are invited to participate because you an elementary-level Georgia Science Ambassador. A total of 16 ambassadors will be recruited for this study. Your participation will require approximately one hour of your time.

Procedures
If you decide to participate, you will complete an online questionnaire and eventually engage in a semi-structured interview. The online questionnaire consists of ten items, which will collect your informed consent to participate in the study, demographic data about yourself and your school district (i.e. gender, age, years of teaching experience, etc.), and your contact information. The questionnaire will take between 5 and 10 minutes to complete, and it can be done from any computer with connection to the Internet. The interview will be conducted at a public location and time of your choosing. The interview will take approximately 30-45 minutes, but it will last no longer than 45 minutes. The interview will be audio-recorded to enable accurate data collection, transcription, and analysis.

Risks
In this study, you will not have any more risks than you would in a normal day of life.

Benefits
Participation in this study may not benefit you personally. However, the results of this study will provide evidence of elementary ambassadors' perceptions and experiences related to the GSAP. Overall, we hope to gain information about the program, which may provide insight into its substantive qualities and functionality, whether specific opportunities or challenges are inherent in its design, and ways that policymakers and leaders can support the GSAP. The participants could benefit from learning how leadership practices and implementation efforts unfold through the GSAP across multiple and diverse contexts, which may lead to improvements in the program design and ambassadors' ongoing implementation work.

Voluntary Participation and Withdrawal

Participation in this research is voluntary. You do not have to be in this study. If you decide to be in the study and change your mind, you have the right to drop out at any time. You may skip questions or stop participating at any time. Whatever you decide, you will not lose any benefits to which you are otherwise entitled.

Confidentiality

We will keep your records private to the extent allowed by law. Only the following people and entities will have access to the information you provide:

- Sheryl Cowart Moss, Ph.D., Principal Investigator
- Charles Harper, Student Principal Investigator
- GSU Institutional Review Board

The information you provide will be stored on the student investigator's password- and firewall-protected computer. The researcher will use a study number rather than your name on study records. All collected data will be exported into statistical software for analysis, and only cumulative summary data will be reported in the findings. When we present or publish the results of this study, we will not use your name or other information that may identify you, your institution, or department. Please be aware that data sent over the Internet may not be secure. The Qualtrics survey system, which will be used to administer the online questionnaire, protects data via encryption. We will not be collecting IP addresses of participants. All study data will be destroyed three years after study closure.

Contact Persons

Contact Dr. Sheryl Cowart Moss at 404-413-8277 and smoss13@gsu.edu or Charles Harper at 404-987-8025 and charper29@student.gsu.edu if you have questions, concerns, or complaints about this study. You can also call if you think you have been harmed by the study. Call Susan Vogtner in the Georgia State University Office of Research Integrity at 404-413-3513 or svogtner1@gsu.edu if you want to talk to someone who is not part of the study team. You can talk about questions, concerns, offer input, obtain information, or make suggestions about the study. You can also call Susan Vogtner if you have questions or concerns about your rights in this study.

Copy of Consent Form to Participant

You can print a copy of the consent form for your record.

If you agree to participate in this research study, please indicate your consent by clicking the "Continue" button below and completing the online questionnaire. Thank you!

[CONTINUE]

APPENDIX E

EMAIL SCRIPT FOR RECRUITING AMBASSADORS

Dear Georgia Science Ambassador,

My name is Charlie Harper, and I am working on a dissertation project as a student researcher at Georgia State University. During the next few months, I will be conducting interviews and administering an online questionnaire as part of a research study on the Georgia Science Ambassadors Program (GSAP). The goal of the research is to increase our understanding of the GSAP by examining the perceptions and experiences of elementary-level Georgia Science Ambassadors. As an elementary-level ambassador, you could potentially provide valuable firsthand information about your own perceptions and experiences related to the program and your efforts to implement the new Georgia Standards of Excellence (GSE) for Science. The questionnaire will take 5-10 minutes of your time, and the interview will last approximately 30-45 minutes but no longer than 45 minutes. The interview will be conducted in person at a location and time of your choosing.

Your participation in the study and your responses to the interview questions will be kept confidential. Security protocols will be used to ensure that personal identifiers are not revealed during data collection, analysis, and write-up of the findings. Each interview will be assigned a study number, and all data will be de-identified and/or anonymized. There is no compensation for participating in this study. However, your participation would be a valuable contribution to the research, and the findings could potentially lead to improvements in the GSAP and support for your ongoing implementation work as an ambassador. Additional information is provided in the "Informed Consent Form" below. After reading the informed consent form in its entirety, if you are willing to participate in the research study, please click the "Continue" button and complete the online questionnaire. The online questionnaire will also include the informed consent form for your reference. If you have any questions, please do not hesitate to contact me. Thanks for your time and consideration.

Sincerely,

Charlie Harper
Student Principal Investigator

REFLECTIVE NOTES FROM EVIDENCE-BASED INSTRUCTIONAL PRACTICES

LEADER TRAINING

GSE Intro Training for Administrators
May 22nd, 2017

(Find, or ask Amanda Buice, for GaDOE ppt.)

* Interesting (& Ironic) → Reading Spillane, Callahen's "Implementing State Standards..." concurrently (in session)

* Observation → Audience is hearing (trying to learn) this info out of context
   - Lecture about what 3-D science is (Compared GPS & GSE → Mmm + 8-M standards)
   → Assumes they have background info and/or expertise. & they are not even paying attention → checking email, texting, ect.

* These administrators HAVE NOT had the same training as Ambassadors → what is THEIR understanding of the new standards and/or the intended implementation process/outcomes

(Admin Audience)
→ They were told ABOUT the Science Ambassador program, but ONLY that ambassadors were developing curriculum maps & assessments (see ppl.)
   → used Apple Model (Adjectives) activity

* Brett using the terms "Conceptualizing" & "Construct Understanding" → same as article p. 410, eta

APPENDIX G

INTERVIEW PROTOCOL FOR AMBASSADORS

Opening: Reintroduce yourself and the purpose of the study, review the informed consent form, request permission to audio-record the session, and ask if the interviewee has any questions.

Interview Questions:

1. (Background) How did you find out about the Georgia Science Ambassador Program and come to be nominated as an ambassador?

   Probe: Did you volunteer, were you asked to serve, was it a competitive process?

   Follow-up: What was your role/position at the time, and approximately how long had you been serving in that role? Has your role changed since becoming an ambassador?

   Follow-up: Were there any other factors or pressures that influenced your decision to participate in the program?

2. (Preparation/Training) Tell me about the training you received as an ambassador (e.g., initial four-days of PL, GADOE webinars, EdWeb online discussions)

   Follow-up: How did the training change your understanding of science standards and science instruction?

   Re-phrase (if necessary): How would you explain to others the difference between the old science standards and the new ones?

   Follow-up: How did the training change your understanding of professional learning?

   Follow-up: Prior to the initial 4-day training you received as an ambassador, did you have training or experience related to adult learning, professional development, or coaching? Did you have any training or experience in leadership or curriculum design?

   Probe: Have you been offered or participated in any additional science training to support your work as a GSA?

3. (Instructional Leadership) Individuals can be formal leaders or they can lead people informally. Can you describe ways that you have helped lead the implementation of the new science standards, either as a formal or informal leader, or both?

   Probe: (e.g., professional learning workshops, webinars, or conferences, developing/sharing resources, etc.)

   - (Listen for individual vs. leader experiences – probe for "leadership" if necessary)

   Probe for details: school/district/etc., number of participants, frequency and duration, etc.

Probe: How do you think the _____ training went? (Specify for each Q3 answer)

4. (Distributed Leadership) Can you describe how other leaders have either positively or negatively influenced your instructional leadership role as an ambassador?

Follow-up: Did other leaders delegate or share leadership responsibilities, processes, decisions? For instance, were any of the implementation efforts that you previously mentioned (Refer back to Q3 responses) a function of shared leadership?

Follow-up: Has the nature of your work, or your status as a formal or informal leader, changed as a result of you becoming an ambassador?

Follow-up: Tell me about your self-perceptions of being a science instructional leader, including your personal level of confidence for implementing the new standards (e.g., planning and leading professional learning, developing resources, etc.).

5. (Positionality) What's it like being an ambassador and also a full-time teacher?

Re-phrase/Follow-up: Does your full-time job as a teacher support or limit your ambassador work in any way?

Follow-up: What level of flexibility, freedom, or discretion do you have in your current role, and how does that affects your work as an ambassador?

Follow-up: Do you have any authority or influence associated with your teaching position that supports or limits your implementation efforts?

6. (Boundary Spanning) In what ways have you collaborated or coordinated with other people or organizations, either within or outside of your school district, to help implement the new science standards?

Follow-up: Have any other individuals reached out to you as an ambassador for assistance or support of any kind?

7. (Support) How would you describe the types and levels of support that you have received for implementing the science GSE?

Probe: Tell me about any funding or resources that have been allocated to support your efforts or the implementation of the Science GSE in general?

Probe: Have specific individuals, groups, organizations provided any other types of support?

Probe: In what ways could building and/or district leaders have provided more support?

8. (Problem-framing) What degree of importance or priority have other leaders in your

school or district placed on implementing the new science standards?

Follow-up: Did principals or other leaders observe or participate in any of your training sessions or other implementation activities?

Follow-up: Sometimes there are multiple initiatives competing for support and resources within a district. Has your GSE implementation work been influenced, either positively or negatively, by any concurrent or competing district goals?

9. Based on the types and levels of support that you have or have not received, how would you describe your own efficacy for implementing the new science standards? By "efficacy" I mean the ability to produce a desired or intended result.

   Follow-up: A recent document from the GADOE referred to ambassadors as teacher-leader that are poised to support professional learning in school environments, with the focus of building the content knowledge and pedagogical skills required to teach the new science standards. How well does that describe you?

   Follow-up: This is a hypothetical question - If the director of the ambassador program called you this afternoon and asked you to share only one idea, a top priority, for improving the Science Ambassador Program, what would your response be?

10. What are your next steps as an ambassador? Do you have any plans for continuing your GSE implementation efforts during the 2018-19 school year or beyond?

APPENDIX H

DEMOGRAPHIC QUESTIONNAIRE

Informed Consent & Demographic Questionnaire

This questionnaire will be used to obtain your informed consent to participate in the study, collect demographic and descriptive data about you and your respective school district, and gather your contact information. Only summary data will be presented in the data and findings, with no personal identifiers.

I have read the informed consent form in its entirety and hereby agree to participate in the research study titled "Perceptions and Experiences of Elementary Georgia Science Ambassadors: What Educational Leaders and Policymakers Need to Know"

    O Yes, I AGREE to participate in the research study.

    O No, I do NOT wish to participate in the study at this time.

Demographic Questionnaire

This section of the questionnaire will collect demographic and descriptive data about you and your respective school district. Only summary data will be presented in the data and findings, with no personal identifiers.

  Gender

    O Male

    O Female

 Age

  [ ]

 Race/Ethnicity

  [ ]

 Total Years of Teaching Experience

  [ ]

Grade Levels Taught (Check all that apply)

- O   PreK and/or K
- O   1st Grade
- O   2nd Grade
- O   3rd Grade
- O   4th Grade
- O   5th Grade
- O   Secondary (Middle/High)

Which of these choices best describes your school district?

- O   Urban
- O   Rural
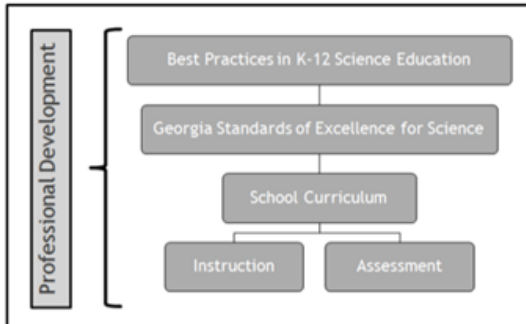- O   Suburban

Contact Information

Please provide a preferred email address and/or telephone number so the researcher can contact you. Thank you!

Preferred Email Address

Phone Number(s)

TRAINING PRESENTATION SLIDES

Best Practices in K-12 Science Education

Georgia Standards of Excellence for Science

School Curriculum

Instruction — Assessment

Professional Development

What else could we do for demonstrating science and engineering practices?

▶ Choose a recorder and a reporter.
▶ At your table brainstorm a list of other activities you could do at your training to engage your audience in using the practices.
▶ Let's share our ideas!

▶ Remember! This is about you planning your training session for your teachers.

Integrating the Three Dimensions

▶ Examples of how to have students progressively develop a deeper understanding over multiple years through actively engaging in scientific and engineering practices.
▶ Remember our levels of Professional Development:
  ▶ Framework of K-12 Science Education
    ▶ Georgia Standards of Excellence
      ▶ School Curriculum
        ▶ Assessment
        ▶ Instruction

▶ Framework pages 217-279

We have guides to best practices in Science Education

▶ Next Step in the Level
  ▶ Georgia Science Standards of Excellence

▶ Guidance for Standards Developers
  ▶ We are not starting over. We have revised what we have to fit the 3 Dimensional Model.

▶ Recommendations: Framework: pages 298-309

School Systems

▶ Use the Georgia Science Standards of Excellence to develop curriculum.
▶ Provide adequate Professional Development to enhance understanding.
▶ Develop and encourage quality assessment incorporating strategies for formative, diagnostic, and summative assessments that inform instruction and evaluate learning that matches the Georgia Standards of Excellence.
▶ Ensure curriculum and instruction reflects these changes and leads student science learning to a deeper level of understanding.

Discussion of Redelivery Action Plan

"If you don't know where you are going, you might wind up someplace else." Yogi Berra

▶ Determine your goal for redelivery.

▶ Determine time allotted.

▶ Develop timeline of activities.

▶ List resources and ideas.

APPENDIX J

BLANK ACTION PLAN FOR REDELIVERY OF GSE TRAINING

Action Plan for Delivering this Information

Questions to Ask	Answers	Time Frame	Resources and Ideas
Who is my audience?			
What do I need?			
What do I have?			
How can I get what I need?			
Who do I need to contact?			
What is my timeline?			

APPENDIX K

VOICES FROM THE FIELD: A COMPILATION OF RECOMMENDATIONS

FROM THE GSA

Quotes related to:

Messaging, Clarity, and Coherence

- *"In terms of a pronouncement of we have to do what? What is the path?"*
- *"We need a plan."*
- *"We have to be able to effectively communicate what we're doing, but it can't be one person because then it's too easy to say "We're not doing that. We're not doing that." It's too easy to swat down one person."*
- *"Give priority on exactly what you would want, what your expectations are for us as we go out and help. Are we showing them how to teach new lessons, or are we showing them how to support the standard with inquiry with the kids, or you know, maybe be a little more clear?"*
- *"It needs to be clear that this is not just new standards that are changing in three years. This is a change in the delivery model. A change in the engagement level. A change in the connection. So it needs to be embedded in everything you do."*
- *"The communication plan could be one of the things on one of those days that everyone's together, and he has his science community together, is to say, how are we going to communicate this? This is what we have set forth. We'll send a letter to the superintendent, a letter to the principal, letter and an email to the whole school from the DOE"*

Funding and Resources

- *"More support in the form of actual materials."*
- *"Making sure that Curriculum maps and curriculum resources are well developed."*
- *"Maybe more guided resources per standard...like here's some great labs."*
- *"Streamlining the resources to get the best and making sure they're vetted labs, more vetted activities that really are going to truly align with the GSE."*
- *"Have each ambassador turn in their most rock star, 5-E, cross-curricular lesson, everything the standard wants. Your best lesson ever and don't try to change it. Don't ask, "Can you write it and put it in this format before you send it?" No, just, you take whatever you think is awesome and you send it to me."*
- *"More resources that teachers had available that would pull...say instead of doing a reading story this week, you have a book to put in the hands of all your students that teaches about the phases of the moon, or life cycles of animals."*
- *"We were working on our lesson plan but we never finished it. And I'm just like, if I had a follow-up with it to finish things...it's just like there needs to be, I don't know, a better way, to have a clearing house to share information."*

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Professional Learning for Teacher and Ambassadors

- *"I would put out an expectation, once a year, no matter what, you need to go to a professional learning, no matter what it is."*
- *"I want to see the state do webinars…have them recorded as well, but do some live ones, so that way you can field some questions from people as well."*
- *"More time with teachers face-to-face is much better than an email or a communication chain."*
- *"I feel like there needed to be a little bit more of the train the trainer approach and less of the figure it out for yourself approach…I need you to tell me some things sometimes.*
- *"We have to find a way to get this redelivered to all the teachers in the state. I mean we just do. We've got to find a way to get professional development out for science for all the teachers in the state and not just the ones that are already passionate about it anyway because we're already going to do it."*
- *"I would go around to all these classes and I would model lessons and I would show them firsthand how to bring the standard to life."*
- *"It's almost like the more you practice it, the more you start to understand what it actually does look like to teach using GSE."*
- *"Well, I am under the mindset that you have fallout from ambassadors, so you have to have a plan of retraining them the same way you do the IB facilitators."*

Professional Learning for Leaders

- *"Because you know what, because doesn't it trickled down."*
- *"I think that's an important thing for our administrators, is for them to actually probably get some kind of training on, here's what you should be looking for in, you know, as your teachers are teaching science."*
- *"I think they need to experience it, you know. I think that if they would have gone through those days of training, they would have understood how much it could help inferring, reading, math skills, higher level thinking skills that we try to teach with book and paper and Pencil…and you get all that with science."*
- *"I think that as a policymaker, I might want to send an administrator with me because some of the pushback I got was just that we're all not trained and I was like, right, and they trained me so that I can train you."*
- *"How do you get the principals at the school to understand how important science is? Yeah, you have to get these principals."*

Training for Pre-Service Teachers

- *"…here's an opportunity. We have a captured audience, so we need to be teaching it the way that it needs to be done."*

Greater Focus on Science in Lower Grades

- *"Just supporting science education in the elementary level. Like, saying that it's important not just in fifth grade."*

- *"More professional learning at the K-3 level, maybe even K-4. More support for our elementary teachers."*
- *"Maybe host more science workshops for lower grades."*
- *"Start setting standards and expectations for science in K-4."*
- *"Gosh, that would be great if K-2 could focus on the claim and evidence and then 3-5 pick it up and add that reasoning part. Wow, that would be just awesome!"*

Integrating Content

- *"One thing that needs to be taught, how to incorporate, integrate science into the other subject content."*
- *"...more ways to integrate science instruction into ELA instruction for primary grades where you're not departmentalized."*
- *"Finding a way to allocate funds that are specifically earmarked for school systems to do some things that integrate reading, writing and science instruction."*
- *"More support for integration and more support at the building level. Saying it is important for all kids to have a well-rounded education."*

Elevated Status

- *"People are not looking at us as being the professional. They're not looking at us as being that connection between the state. It's almost like the state needed to introduce us like individually. Hey, so and so county, here is your science ambassador. She's here to do training for you on our behalf. You know, and have that support to make it seem like it's more...I don't feel like we're taken seriously."*
- *"They could have made our roles a little bit more important and actually allowed us to conduct PL with not just maybe the elementary school but with everybody."*
- *"The other thing I would do is I would probably have the science ambassadors connect differently with the staff only because most of the staff didn't know I was a Science Ambassador."*
- *"They [GSA] have to be allowed to say "That's not correct.""*
- *"I think that we would need someone important from downtown in each district. A director of curriculum and instruction, someone high up in the food chain that can feed it down."*

Structured Collaboration

- *"I think time given to...you know, once a quarter, come back, let's meet as a whole. Providing that time. I think you'd have more effective use of your ambassadors."*
- *"It doesn't have to be frequent, but just maybe once a semester, like twice a year, have us come together, and create opportunities for us to collaborate, for us to discuss, for us to plan."*
- *"I wish we had more time to collaborate, like for the teachers to come back all together and talk about what did you find out? What worked for you? What is your district doing? How are you guys implementing the standards? How's it going? How are you assessing those standards? How are your kids doing? Which standards do you find your kids are weakest in?"*

- *"When we have these conferences, like at the STEM Forum, at GSTA, why don't they have where we all can have a powwow together here and either share, or just vent, or a mini-training session, you know, something. Even if it was a breakfast meeting or something, just to say, hey, we're still here, and we're still...from their perspective, like, "Hey, you know, thank you. We see you trying" and get feedback from us."*
- *"Find some way to get us to come together, you know, even if it's at a RESA, you know, we're going to have a science ambassador PL session through the RESA where all the science ambassadors and the CRSA came together, and we talked about how are things going? What do we need to work on? What are the things that we're seeing? What lessons have y'all come up with? And share those ideas."*
- *"I would like to meet again. That was very powerful. If it looks like just additional training, or a follow-up piece, or what's happening, it was nice to be able to collaborate with other ambassadors."*
- *"I want to know what other counties are doing. I want to know what is it that they're doing, what's working there that might not be working here? What trick did you come up with, or where did you get a resource for your phenomenon? Where did you get your resource for your plan, your investigation?"*

Time and Support

- *"The support we need…it has to come from administrators."*
- *"It takes time, but we've got to be given that key, we've got to be given an opportunity to get in that door. And I don't think that's what's happening."*
- *"Put me in a school and do a study - let me teach science, let's have just one grade, everyone teaching science the right way, and let's see how it does to all the other subjects. Let's see how the kids feel about themselves"*

Testing

- *"Until it becomes a test topic, nobody's going to make that a priority in their school."*
- *"I think it needs to be tested all years. And you know why I say that? Only for the importance, because then I know that it's going to be covered, because I understand the importance."*

Maintain a Steady Course

- *"I do think keeping it on the same path is going to be something in the future that's important. We tend to jump sometimes at the teaching method of the week."*
- *"I think just the challenge of keep moving forward with science, and that's just a perennial challenge for anybody is just keep moving forward and keep bettering and bettering."*
- *"There's no point in pouring all this into science ambassadors and then it just stops there"*

APPENDIX L

JOURNEY AND REFLECTION OF THE RESEARCHER

My doctoral work in educational leadership and policy studies progressed concurrently with my GSAP training and my district leadership role as a science instructional coach. This favorable conjuncture of academic, professional, and policy endeavors is where the idea of a GSAP case study was born. I sought to characterize the GSAP by describing and analyzing ambassadors' perceptions and experiences, and that naturally entailed my own story. My anecdotal account would arguably have more credence within an auto-ethnographic research design (Mitra, 2010). Fortunately, the case study transcended a lone K-5 instructional coach's perceptions and experiences (my own) to provide empirical data from 15 other ambassadors.

My inside perspective has afforded valuable firsthand knowledge and experiences, which arguably qualified me as a primary and legitimate source of data for the study. My embeddedness in the GSAP offered accessibility to GSA informants and other critical data sources, and it also rendered credibility to my own perceptions, experiences, and personal accounts. A primary question that I struggled with was whether or not to explicitly contribute my perceptions and experiences to the study. I understood Malterud's (2001) stance that a researcher's background, position, and perspectives probably shape most aspects of their research, and I agreed with Merriam's (2009) claim that authors should articulate and clarify their dispositions, assumptions, experiences, worldviews, and theoretical orientations to the study at hand. I recognized both the advantages and ethical precariousness of my dual roles of researcher and data source. At the same time, my expertise in science education, combined with my grasp of educational leadership and policy, were two important attributes that were inseparable from the scope and aim of the research. Those assets were convenient and favorable

for close interpretation and a thick, accurate description of the data. I ultimately decided that the inherent biases created by my emic perspective might be somewhat balanced with the potential benefits of fully disclosing and chronicling my own experiences as a GSA. Each ambassador's story contained data that was used to characterize the GSAP and detail the practices and supports that have benefited or impeded the program's mission. My own GSAP endeavors included successes, struggles, and failures, and the story warranted inclusion because it represented a compelling reality, a single perspective in a mosaic of 15 other unique GSA realities.

It is important to understand that, from a constructivist point of view, my own background, perceptions, and experiences as a science instructor are inextricably tied to my research. In fact, my passion for science education, interest in policy, and involvement in various leadership circles actually gave rise to the GSAP case study. The opportunity to study the GSAP took shape gradually and serendipitously, then presented itself to me rather unexpectedly. In a sense, I just happened to be at the right place at the right time, and fortunately I recognized the tremendous potential my circumstances afforded. The following narrative includes a detailed timeline (see Appendix E) of the sequence of events, interactions, and choices that led me to study the GSAP as well as my personal thoughts and reflections throughout the process. My goals were to paint a vivid picture of the contextual factors and personal beliefs that underpinned the case, affirm the logical rationale of the study, and hopefully inspire a greater appreciation for the research. As it turned out, my story was strikingly similar to many of the ambassadors whom I interviewed.

Becoming a Science Leader. In May of 2015, as a classroom teacher, I enrolled in a one-year performance-based leadership certification program at Georgia State University, which required me to lead a school improvement initiative. By the following April, I had collaborated

with my principal and several colleagues to begin a three-year process for STEM school certification by the state department. I orchestrated a project to transform my school's courtyard into an outdoor classroom and gardening center, and I volunteered to serve as the Science Olympiad captain for my school. My active involvement in these two endeavors fostered communication a familiarity between me and the district Science Curriculum Coordinator. On April 14, 2016, the science curriculum contact person at my school disseminated an email from the science coordinator, which stated, "If you're interested in serving as a Science Program Ambassador, please complete the attached form and send it to me by April 20th." I was in my ninth year of teaching, and at the time I taught third, fourth, and fifth grade gifted/talented students. As the Enrichment Program teacher, I was able to incorporate STEAM (Science, Technology, Engineering, Art, and Mathematics) instruction, which I admittedly had a preference for. I taught fifth grade science during my first five years in education, and my next four involved STEM learning with first through fifth graders. My affinity for STEM education was largely due to my prior undergraduate work in middle grades science and my prior technical background as a mechanic in the U.S. Air Force and at Delta Airlines. When I saw the advertisement for the GSAP, it struck me as a promising leadership opportunity that simultaneously supported my professional pursuits, academic goals, and personal interest.

   ***A Trio of Roles: Leader, Ambassador, and Researcher*.** I applied for the Georgia Science Ambassador Program, and in May of 2016 was selected as a one of 299 ambassadors from across the state. I was one of four elementary-level science ambassadors in a district that operated 14 elementary schools and served approximately 20,000 K-12 students. Coincidentally, the GSAP program began at precisely the same time that I embarked on my doctoral path. My initial two-days of GSAP training occurred in June of 2016, a mere two weeks after I launched

into a three-year cohort program at Georgia State University (GSU) to earn an Educational

Doctorate Degree (Ed.D.) in Educational Leadership. I was a full-time teacher, full-time

graduate student, and a GSA in training.

I participated fully in all GSAP training sessions, collaborated with other ambassadors to

plan and carry out professional development targeting the new science standards, and confronted

both challenges and opportunities in my role as a GSA. During the very first GSAP training

session, I recognized opportunities and challenges related the GSAP mission. I noticed that

elementary-level ambassadors had very diverse professional roles (classroom teachers,

instructional coaches, curriculum directors, etc.), levels of experience (first-year teachers to

veterans with over 20 years of tenure), inclinations toward the GSAP training (enthusiastic to

indifferent), and conceptual understandings of the new science standards. When the training was

complete and we moved into the active implementation phase, it became apparent that

distribution of leadership and support, both across and within school districts, was quite

disparate.

Interestingly, in July of 2016, two months after I joined the ranks of Georgia Science

Ambassadors and my GSU cohort, the board of education in my district approved a measure to

create a new position titled K-5 Instruction Content Coach (ICC) for Science. It was a district-

level coaching position to support the K-12 Science Coordinator's efforts, help facilitate the roll-

out of the new Science GSE, and support the science curriculum needs of 14 elementary schools

in the county. I applied for the position, was selected as the new Science ICC, and immediately

went to work learning and defining the new role. It was an exciting time of transition and

growth for me, but the challenge of three major, simultaneous learning curves was somewhat

daunting. I remember thinking to myself that my work as an ICC, GSA, and graduate student

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seemed to be somewhat mutually supportive, especially since my anticipated dissertation topic was about STEM focused schools and my new position would likely involve STEM instructional support for elementary teachers. I was encouraged by the potential overlap and connectedness between the three roles, but I could not have predicted the convenient path that my dissertation work eventually took and the coupling of my academic and professional roles.

GSAP Indoctrination: *Gaining a New Paradigm*. The first two days of GSAP training, in my opinion, exemplified high quality science professional development. Prior to the training I had a high level of self-efficacy as a science teacher, but I can honestly say that, as a result of those initial two-days, I adopted a new paradigm about what effective science instruction should look like. I was generally familiar with the Next Generation Science Standards (NGSS), but the concept of 3-Dimensional Science Instruction was completely new to me. I clearly recall being intrigued and humored by the fact that, although I had been a science teacher for nine years, I felt like I was learning an entirely new and powerful way to teach science. I would later find out that many of my fellow elementary teachers in the room felt exactly the same way. I may have arrived that first morning expecting a thorough overview of the new standards, explanations and elaborations of the content, and a Q&A session to answer all of our questions. What I got instead was full immersion in a 3-D science lesson, which left me feeling a little bewildered, like a student with more questions than answers. The lesson challenged my own understanding about a seemingly simple science concept (solids versus liquids), and it invoked mixed feelings of perplexity and eagerness.

The anchoring phenomena for the sample lesson was to decide whether sand was a solid or a liquid. The trainer prompted us move beyond the textbook definitions and construct our own understanding and descriptions of solids and liquids. He engaged the group with science

and engineering practices – we worked in small collaborative groups to obtain, evaluate, and

communicate information, ask questions, construct explanations and arguments, and develop

models – although he did not explicitly teach or discuss any of the eight practices during the

investigation. At the time, I was not aware of the three components of 3-D Science or the

concept of using anchoring phenomena, so I did not realize that the trainer was creating an

experience, a context, for introducing the 3-D instructional model. I remember feeling

inadequate as a science teacher and thinking to myself that I was out of my league, but at the

same time I was eager to learn more. The anchoring phenomenon and 3-D instruction had its

intended effect, because I was hooked, engaged, and the learning was obviously enduring. The

epiphany for me was that I wanted my students to have that same sense of wonder and intrigue, a

genuine and intense curiosity about their world, and a different understanding of the nature of

science that was no so much about facts and memorizing information. I understood at that

moment that science instruction in Georgia was not as appreciable and impactful as it could be,

which was essentially why we were all there being trained and indoctrinated as Georgia Science

Ambassadors.

Gaining a Policy Perspective and Switching Gears. In August of 2016, after the first

two days of GSAP training and before the final two-day session, I began studying educational

policy analysis as part of my required doctoral coursework. The course was titled *Educational

Policy Making and Analysis*. It is worth noting that, even though I had recently completed my

educational leadership endorsement, my understanding of organizational and policy dynamics at

that point in time was rudimentary at best. However, as I soon gained a more in-depth

understanding about policy applications, policy tools, implementation challenges, and the

concept of street-level bureaucrats (i.e. teachers being the primary implementing agents of

educational policies). I eventually recognized the GSAP as an authentic and captivating example

of policy implementation in action, not to mention the fact that I was an agent in that process.

Furthermore, the GSAP presented an interesting and rich opportunity for conducting research. It

was an intriguing thought, but I was reluctant because I had already done a considerable

literature review related to STEM school leadership.

As the 2016-17 school year ramped up, I began working as the district's brand-new K-5

Science Instructional Coach to implement the GSE for Science. Naturally, I perceived every

aspect of my daily work through my newly acquired policy lens. I noticed how language

influenced teachers' understandings of the new standards, how leaders framed the GSE as either

important or inconsequential, how some individuals acted as boundary spanners by connecting

with outside organizations, and how leadership responsibilities were sometimes distributed but

more often withheld from those individuals that were best situated to lead and teach. I also

observed how power and positionality seemed to determine whom got invited to important

conversations, how decision-making processes unfolded, levels and types of support offered, and

the extent to which competing priorities or other policy initiatives affected implementation.

Although I became continually fascinated by the way policy and leadership seemed to pervade

the GSAP and connect my professional and academic worlds, I was still not ready to abandon

my STEM School Leadership focus and the work I had invested into that topic.

My essential responsibilities as the K-5 Science ICC in my district was to help roll out

the new Science GSE. I collaborated with three other elementary science ambassadors in my

district to plan and conduct GSE implementation training, answer questions about the standards,

and provide general support to teachers as they grappled with the GSE. I would argue that we

received a high level of support from our district science coordinator. We decided to use a train-

the-trainer model during the 2016-2017 school year, prior to state-wide implementation the following year, to train and prepare teachers for the changing standards. Duty leave was provided for three teachers at each of the 14 elementary schools so they could attend a three-day training series; the three days were staggered throughout the year, with the first occurring in October, the second in December, and the third in March). Administrators at each school were asked to nominate their Science Curriculum Contact Person (CCP), one teacher as a K-2 representative, and a teacher from the 3-5 grade-band for the professional development. The plan was for each 3-person site-based team to redeliver the training to the teachers and leaders at their respective schools. These individuals were designated as school-level GSE Science Ambassadors, a title which differentiated them from Georgia Science Ambassadors.

In addition to the investment in human capital for rolling out the new standards, the district purchased a variety of science equipment to better equip each school for the hands-on learning called for in the Science GSE. For example, each elementary school received an array of weather instruments, a set of digital pocket scales, tornado tubes, electrical energy balls, and melting blocks. Even more impressive was that each school was given an extensive battery of innovative wireless digital science probes, which were purchased from the company PASCO Scientific. All teachers in the district participated in a one-day training for how to use the PASCO probeware. Additionally, every teacher was given access to National Science Teachers Association (NSTA) resources, including the *Picture Perfect Science* series, *Uncovering Student Ideas in Science*, *Differentiation Strategies for Science*, *Reading Strategies for Science*, and *Writing Strategies for Science*.

As it turned out, the train-the-trainer model for GSE implementation was a complete and utter failure. At the outset of the plan, I considered the fact that site-based teams would have

considerably less time to redeliver the equivalent of their three days of training, but I was

surprised to learn that some teams were given no opportunity to share the information. Only one

elementary school coordinated a two-hour training session for their representatives to train each

grade level, but two hours was the exception rather than the rule. The typical allotment of time

was approximately 30 minutes which usually occurred during an afterschool faculty meeting

with the entire staff. The second most common redelivery approach was a single session with

each grade grade-level during their planning time. It is not very difficult to imagine the inherent

challenges with any of the three previous strategies, not least of which is condensing 3-4 days'

worth of content into 30 minutes at the least and 120 minutes at best. As detailed in the findings,

I discovered that this scenario was the rule rather than the exception, and that many other science

ambassadors throughout the state faced similar time challenges. I was also troubled to see the

science equipment and probes idly stored in science closets and labs, largely underutilized or

altogether unused. As recently as January 2019, the science equipment that was purchased

within the past three years was still in its original packaging, unopened and unused, stored in

closets, cabinets, and corners at most of the elementary schools in my district. This typified

another interesting finding, which was that many districts did not have adequate equipment and

supplies, but those that did have them oftentimes did not utilize them.

In retrospect, I should not have been too surprised at the underutilization of our school-

level ambassadors, resources, and equipment. During the document analysis phase of my

research, I reviewed and analyzed training documents and reflective notes from a one-day GSE

seminar, which the GADOE provided for school and district leaders in May 2017. The session

was titled "Evidence-Based Instructional Practices for Supporting the Science Georgia Standards

of Excellence (GSE)." It provided district and school administrators with an introduction and

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overview of the GSE, 3-Dimensional Science Teaching and Learning, the Partnership for

Effective Science Teaching and Learning (PESTL), and an observation instrument known as the

PESTL Observation Protocol for Science (POPS). I was invited to the training because I was a

district-level instructional coach, so I was among an audience of mostly non-GSA administrators

who were learning about GSE and 3-D Science for the first time. During the same month of the

seminar, I had completed two more required doctoral courses, *Qualitative/Interpretive Research*

in Education and *Advanced Educational Leadership*. The sequencing of these two classes with

my previous policy studies and my GSAP work had me seriously contemplating my dissertation

topic, and I went into the one-day seminar with the notion that it might help me decide. The

workshop was the turning point for me. After participating in the once-and-done leader training,

comparing and contrasting it with my previous GSAP training, and reflecting on my year-long

experiences as an ambassador, I realized the plight of elementary GSA. I felt sure, based on my

circumstances and interest, that I should switch my dissertation topic and study the GSAP

despite the previous work that I had accomplished for STEM school leadership. I entered my

second year as an elementary science instructional coach knowing that I was simultaneously a

science leader, science ambassador, and novice science education researcher.

I usually try to learn from my mistakes rather than repeat them, so the following year

(2017-2018) I decided to start over at square one and test a new professional learning (PL) model

for GSE implementations. Instead of a train-the-trainer approach, I asked my supervisor, the K-

12 Science Coordinator, to allot funds for duty leave so that I could conduct site-based GSE

training. She agreed to fund enough substitute teachers for me to spend an entire day at each

elementary school, a full two hours with every grade band (e.g., Kindergarten &1st from 7:30-

9:30 am, 2nd & 3rd from 9:45-11:45 am, and 4th & 5th from 12:30-2:30 pm). It was focused

training with virtually every K-5 classroom teacher in the county. I provided an introduction to the new Science GSE and 3-D Science Instruction, and based on feedback survey results, the outcome was a drastic improvement over the previous year. However, it was still a two-hour cram session of highlights and main features from the GSAP training, which was intended to fundamentally transform teachers' conceptions of what science teaching and learning should look like. I personally believed that a two-hour training could not possibly accomplish that vision, but it was a great start. Again, the district purchased more hands-on science supplies for each school, including a set of density cubes, radiation cans, a coin-and-feather tube, more digital pocket scales, an air cannon, resonance boxes, small hovercrafts, and other supplies.

Throughout the course of my first two years as a science coach, I worked to support teachers with science by conducting professional learning, developing instructional resources, modeling lessons, and bridging people and organizations within and outside of the district. I was able to accomplish those things because that was precisely my job description, but I realized early on that it would not have been possible had I remained a classroom teacher. That prompted me to wonder how well other ambassadors across the state were doing. Did many others move into formal leadership roles or were they trying to serve in dual roles as classroom teacher and instructional leader? Were their building and district leaders giving them autonomy and freedom to make decisions, plan and carry out professional learning, and order science equipment? Did they have the same understanding of the new standards and 3-Dimensional Science, and how did they convey that information to teachers and leaders in their district? All of these curiosities led to the formation of my research questions and the direction my study would eventually take.

During my first two years as an academic coach, I gained a keen understanding and profound appreciation of teachers' daily struggles. I attended meetings in which the principal

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clearly stated that literacy and math are the top priorities and that was where the focus had to be. I watched the adoption of a literacy program that subsequently dominated elementary teachers' planning and instructional time. I have seen master schedules that only allowed for 30 minutes of instructional time per day for science and social studies combined. I have conducted at least two dozen professional development sessions related to the GSE and 3-D Science, none of which were attended by the principal, assistant principal, or any other administrator. This pervasive inattention to science training prompted questions about administrators' observations and evaluations of science lessons. It also caused me to wonder how building leaders could properly support teachers to implement the GSE and 3-D Science Instruction if they themselves were not able to accurately characterize the new standards and their intent. I met teachers that would only plan and implement 3-D science lessons when their administrators were away from the building because they knew the lesson would not be observed. Those classroom teachers were unwilling to take the risk of a marginal evaluation of a science lesson that did not align with the evaluator's understandings and expectations. Human tendency to prefer the status quo means that teachers are much more likely to maintain their current practices rather than switching to new and unfamiliar approaches (Spillane et al., 2006), especially at the expense of receiving a negative rating from an administrator who is uninformed about the instructional innovation being implemented.

My teacher friends and colleagues frequently shared legitimate concerns and struggles, and I empathized and sympathized because I had faced those same challenges as a GSA, albeit from a slightly different perspective. Whenever I conducted GSE implementation training, I emphasized the importance of engaging students in science as opposed to simply teaching them about science. The teachers countered with, "We know it's important and would love to teach

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that way, but the priority is English Language Arts (ELA) and math, so we barely have time to even squeeze in science and social studies." My brightest and best appeal for them to integrate content fell flat because, in their own words, "The new reading program and the math curriculum does not allow for that." Their sense of frustration and resignation was palpable, and the best response I could offer was a smile, a nod, and an acknowledgement of "I know, I understand. I get it." That was my struggle as an elementary science instructional coach, and I valued and internalized each of those conversations. I was fortunate to have been part of a state-led initiative, to have gained a district-level perspective of leadership and support, and that I am not too far removed from the realities of school-level operations and classroom instruction. Those vantage points, along with the policy perspective and leadership dispositions acquired during my doctoral journey, have enabled me to see the big picture and understand the systems nature of my work. Consequently, I have a great deal of empathy for classroom teachers, leaders at every level, and most importantly the ambassadors that have attempt to lead and serve both groups. At the same time, I feel an exceedingly high level of hope and encouragement for this research to change and improve the existing system. During one of the interviews, an ambassadors remarked that she wanted to be like a pebble that gets thrown into a pond to create a ripple effect that spreads across the entire body of water. Her analogy was powerful and appropriate, portraying exactly what elementary-level science ambassadors were intended to do and desire to do. My hope is that this research project is a sizable and significant pebble.