School District Science Coordinator Professional Development (Paper 3 in Paperset)

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Abstract

This paper discusses the impact of the second New Science Coordinators Academy (NSCA), which is one of four components of *Virginia Initiative for Science Teaching and Achievement* (VISTA), a U.S. Department of Education (USED) a science education reform grant. The NSCA is designed to support new science coordinators/district liaisons (less than five years of experience) and to continue building the state science education infrastructure. Research in education leadership traditionally focuses on teacher leaders, principals, and district office personnel. Interestingly, research on district office personnel rarely distinguishes between the different roles of district personnel. This paper seeks to inform the field by sharing the impact of an academy designed for new coordinators on their learning and to begin to understand their role and impact in their district. The five-day academy engaged participants in a variety of experiences designed to address six goals. The data indicate that the second NSCA was successful at meeting its goals to support the participants and to build a common language among these new coordinators. Initial data also supports the variety of responsibilities of these participants and the positive impact of the academy on their district work.

Keywords: inquiry-based science, problem-based learning, science coordinators, professional development, VISTA

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"Leadership matters" (Leithwood and Wahlstrom, 2008). If so, which levels of leadership impact student achievement- district/central office and/or school level? With education professionals scrambling to improve teaching and learning in schools, the question of what types of leadership are needed to make the desired improvements remains.

Recent studies have looked at teacher leaders, principals, and central/district office leadership (Honig, 2006, 2010, 2012; Leithwood & Wahlstrom, 2008; MacIver & Farley, 2003; Sebastian & Allensworth, 2012; Spillane, 1999, 2000). Researchers in science education have studied the role and impact of science teacher leaders (Rhoton, 2010). Research examining principals and central/district office leadership has predominately occurred in the field of education leadership and focuses on their activities and role as an aggregate group when examining their impact on schools. Reports such as those by Louis, Leithwood, Wahlstrom, and Anderson (2010), Honig, Copland, Rainey, Lorton, and Newton (2010), and Bottoms and Schmidt-Davis (2010), do not distinguish between leadership levels or job responsibilities.

The lack of research on the various leadership levels raises an important question for educators of science and other content areas. Is pedagogical expertise sufficient, or is specific content and pedagogical content support necessary to impact student learning in particular content areas, such as science? The literature provides no insight into the importance of content expertise for district leaders. As science educators, we believe that content knowledge is important for teachers. Like Spillane and Callahan (2001), we believe that science leaders in schools and at the district level must have a "sufficient" level of science content and science pedagogical content knowledge to provide the expertise and support teachers need.

The *Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas* (2012) and soon to be completed *Next Generation Science Standards* (Draft 2013) call for science leaders to be active within their districts to support the changes proposed by these documents to curriculum, instruction, and assessment. The recent release of the *2011 Trends in Mathematics and Science Study* shows that we are still not achieving at the levels of many countries. As a nation, there is a strong push to increase the number of highly prepared STEM professionals. How can we improve student achievement and interest in science without science leaders at the district/central office level working with principals and teachers to improve instruction? We cannot. We must have effective science leaders in districts, as many times they are the conduit of knowledge and opportunities to principals and classroom teachers. Without an understanding of their role and impact on improving student achievement, we cannot justify their work and the necessity of their expertise.

The goal of this paper is to begin looking at the impact of district/central office science leaders. These leadership positions may constitute science coordinators, science directors, science leaders, or science liaisons. To begin this examination, this paper will examine the impact of a science leadership academy (5 days) on a group of new science leaders from district/central offices across the Commonwealth of Virginia. The work accomplished inside the academy and in their districts because of the academy is our focus.

Virginia Initiative for Science Teaching and Achievement (VISTA) is a five-year Investing in Innovation (i3) grant funded by the U.S. Department of Education. One component of the project is a five-day leadership academy to build, support, and sustain district level staff for district/central office personnel newly (under five years in their position) designated as the science leader/liaison/coordinator.

Research Questions

The following questions guided assessment of the impact of the New Science Coordinators Academy (NSCA): 1) To what extent do the science coordinators gain knowledge about each of the NSCA goals during the five day NSCA? 2) Which goals of the NSCA were viewed as most beneficial to the science coordinators? 3) What needs do the science coordinators express to facilitators are not met by the NSCA? 4) To what extent do the science coordinators use the new knowledge in their district work?

Review of the Literature

An Overview of Educational Leadership Research since the 1970s

Over the last 40 to 50 years, the focus of research inn educational leadership arena has shifted.. In the 1970s and 1980s, Fullan characterized the role of district leadership as assisting with the "innovation implementation" era of change (Fullan, 1985). The research during this time focused on how districts could support the implementation of new programs and practices. As some schools within a district showed improvement and others did not, the focus of research shifted to the school level. District level impact was seen as minimal on implementing new practices and programs.

This ushered in a period of research on effective schools. The "effective schools" movement focused on the school as the unit of change for impact on teaching practice and student achievement. Studies during this time, such as Floden, Porter, Alford, Freeman, Susan, Schmidt, and Schwille (1988), indicated that district influence on instructional decisions and classroom practices were minor. Only a few studies highlighted the role of school districts on educational change (Fuhrman & Elmore, 1990). However, the research did not focus on linking student interventions and student learning. Case studies in the late 1990s on school district

transformation, conducted by researchers such as Spillane (1996, 1998) in Michigan and by Elmore and Burney (1997) in New York City brought the role of the district back to the forefront. As noted by Leithwood, Louis, Anderson, and Wahlstrom (2004), these studies confirmed that some districts can and do have a positive impact on schools, teachers, and student achievement.

Characteristics of Effective or Successful School Districts

A 2005 review of the research by the American Institute for Research (AIR) identified seven primary and four secondary themes based on analyzing 20 studies (Table 1). In a more recent synthesis study by Leithwood (2010) of districts serving a high proportion of underserved students , Leithwood found ten characteristics across the thirty-one studies of high-performing districts (Table 1). The number of studies that identified each characteristic ranged from four to sixteen. None of the characteristics was found to be overwhelmingly identified or significant in its impact. Leithwood indicates that these studies have significant limitations because the identified characteristics are from "outlier" research designs that do not allow for the separation of which characteristics are necessary and which are sufficient to support student learning. This study, however, does provide suggestions for districts to consider while realizing that systemic reform is complex, non-linear, and requires leaders who are flexible and feedback loops that allow for alterations in alignment and changes in roles within the district (Leithwood, 2010).

Table 1
Comparison of Characteristics of Effective Districts

AIR Report, 2005	Leithwood, 2010
Successful districts focus first and foremost on student achievement and learning. All leadership is instructional leadership.	District-wide focus on student achievement
Successful districts have a theory of action for how to effect improvements, and they establish clear goals.	Approaches to curriculum and instruction
Commit to professional learning at all	Use of evidence for planning,

levels and provide multiple, meaningful learning opportunities	organizational learning and accountability
Use data to guide improvement strategies	District-wide sense of efficacy
Enact comprehensive, coherent reform policies	Building and maintaining good communications and relations, learning communities, district culture
Have educators who accept personal responsibility for improving student learning and receive support to help them succeed	Investing in instructional leadership
Monitor progress regularly and intervene if necessary	Targeted and phased orientation to school improvement (targeting interventions on low performing schools/students)
	District-wide, job-embedded professional development for leaders and teachers.
	Strategic engagement with the government's agenda for change and associated resources
	Infrastructure alignment

Role of District Leadership in Principal Learning

Recent studies have focused on the relationship between district office leadership and principal leadership and learning. In 2010, three large independent studies examining the impact of school district leadership on principal learning and ultimately on student achievement were released. All three studies were funded in part or wholly by the Wallace Foundation. The Southern Region Education Board (SREB) report describes three essentials to producing effective high schools: state capacity building, district vision, and principal leadership (Bottoms, 2010). All three essentials are needed and are rarely found working in sync. For purposes of this paper, their consideration of district interaction with principal leadership was of interest. They

identified seven strategies necessary for the support of principals as instructional leaders. These seven strategies are:

- Strategy 1. Establish a clear focus and a strategic framework of core beliefs, effective practices, and goals for improving student achievement.
- Strategy 2. Organize and engage the school board and district office in support of each school.
- Strategy 3. Provide instructional coherence and support.
- Strategy 4: Invest heavily in instruction-related professional learning for principals, teacherleaders and district staff.
- Strategy 5: Provide high-quality data that link student achievement to school and classroom practices, and assist schools to use data effectively.
- Strategy 6: Optimize the use of resources to improve student learning.
- Strategy 7: Use open, credible processes to involve key school and community leaders in shaping a vision for improving schools. (pp. 1-2)

The second study by Honig, Copland, Rainey, Lorton, and Newton (2010) found that districts generally do not see district-wide improvements in teaching and learning without significant engagement of the district office personnel in helping all schools build their capacity for improvement. The district office personnel need to work as an integral part of school improvement efforts. They are essential for building partnerships with school leaders and for building "capacity throughout public educational systems for teaching and learning improvements." The research identifies five areas necessary to bring about the improvements desired:

- Dimension 1: Learning-focused partnerships with school principals to deepen principals' instructional leadership practice.
- Dimension 2: Assistance to the central office-principal partnerships.
- Dimension 3: Recognizing and reculturing of each central office unit, to support the central office-principal partnerships and teaching and learning improvement.
- Dimension 4: Stewardship of the overall central office transformation process.
- Dimension 5: Use of evidence throughout the central office to support continual improvement of work practices and relationships with schools. (p. *v*)

In the third study by Louis, Leithwood, Wahlstrom, and Anderson (2010), the researchers highlight several conditions allowing district office staff to impact principal and students learning:

- Districts that help their principals feel more efficacious about their school improvement work have positive effects on school conditions and student learning.
- Principals who believe they are working collaboratively toward clear and common goals—with district personnel, other principals, and teachers in their schools—are more confident in their leadership.
- District size is a significant moderator of district effects on school-leader efficacy; the larger the district, the less the influence.
- School level is also a significant moderator of district effects on school-leader efficacy, with districts having larger effects on elementary than secondary school leaders. (p.129)

They also found that in higher performing districts, the district led in the development of curriculum and learning standards aligned with and exceeding those of the state. In addition, the

districts identified intervention and improvement strategies that go beyond the state requirements (Louis, Leithwood, Wahlstrom, & Anderson, 2010).

These three studies highlight the need for a strong and supportive relationship between district office personnel and principals in all school buildings. These papers do not define the positions of the district office personnel in terms of content or pedagogical expertise. In the 2010 paper by Honig, Copland, Rainey, Lorton, & Newton, the district office personnel involved with principals are designated as Instructional Leadership Directors (ILDs) at the executive leadership level. A 2012 paper by Honig examines the practices of the ILDs in detail. She indicates that the three districts in this study had the ILDs reporting to the superintendent's cabinet or similar level to highlight the importance of this work in the district. The level of reporting emphasized the importance of their role and the authority to help the principals improve their practices.

Role of Science Coordinators in working with Principals, Teaching Practice, and Student Achievement

No studies were found that examined the impact of science coordinators/liaisons on the work of principals, teachers, and student achievement. This finding is confirmed by other researchers who have noted this missing area in the literature (Levy, Pasquale, & Marco, 2008; Miller, 2010). The lack of knowledge of their impact on principals, teachers, and students may be a critical link in improving student achievement.

Structure of the Academy

For this second year of the academy, participants convened for three days initially in the fall of 2011 and then again for two days later in the spring of 2012 , with additional networking and support at the Virginia Science Education Leadership Association (VSELA) meeting in the fall of 2011 and spring of 2012. The NSCA has six goals for participants. The goals are to:

1. Learn to make improvements in leadership, teacher learning, quality teaching, and student learning.

2. Develop a common understanding of hands-on science, inquiry, problem-based learning, and nature of science.

3. Identify aspects of effective science teaching and learning.

4. Compare district models of creating standards-based science curricula.

5. Investigate data sources available to use to provide a focus to improve district science programs.

6. Develop a science program strategic plan.

The goals of this NSCA are ones identified from collaboration with experienced coordinators across the state and the needs of VISTA. Our aim is to meet the needs of new science contacts/liaisons/coordinators. These goals also match those identified by research on supporting policy implementation and instructional reform conducted by Marsh and colleagues (2002, 2005). The facilitators address these goals by weaving a variety of activities and opportunities to revisit the goals throughout the five days.

The first day of the NSCA (see Appendix for a detailed daily schedule) engaged the participants in an introduction to VISTA, an introduction to the other participants and VISTA staff, and then a daylong simulation, *Building Systems for Science Literacy*. Kathy Stiles of WestEd facilitated this simulation, which is under development by WestEd. The game is based on the ideas and principles of *Designing Professional Development for Teachers of Science and Mathematics* (Loucks-Horsley et al., 2009). The simulation allows players to "discover what activities and resources have the greatest impact on teacher and student learning, why some teachers struggle to improve their instructional practices, and how much it 'costs' in time,

materials, and commitment to provide effective professional development" (Playing, 2009, p.19). These activities promote Goals 1, 5, and 6.

Day 2 of the NSCA began by engaging the participants in a model problem-based learning lesson. After participating as learners in the lesson, the participants discussed, "How can we identify effective teaching?" This led to the introduction of the VISTA definitions for hands-on Science, inquiry, problem-based learning (PBL), and nature of science. (NOS). Science educators in Virginia developed the definitions for Hands-on Science and PBL to be used in common across the VISTA program. The definition for inquiry came from the *National Science Education Standards* (1996) and focuses on the five essential features of inquiry (Inquiry and NSES, 2000). Virginia has added specific aspects on NOS into its state standards. These aspects are the focus of the discussion and work of VISTA. The second half of the afternoon focused on examining different data sources and developing an action plan. The participants examined data from TIMSS, NAEP, AAAS, and school district data. This examination of data led to a discussion of what the data tells us are gaps in student learning. The participants received a tool to identify and organize the gaps from their data. From this tool, the participants began to identify actions to take in the future. These actions were organized into another tool that organized and prioritized actions, tasks, and included a timeline. These activities promote Goals 1, 2, 3, 5, and 6.

Day 3 focused upon engaging participants in expanding the action plan into a more detailed teacher professional development plan. In addition, we wanted to provide the participants with the opportunity to get ideas from other science coordinators from across the state. To accomplish this, we brought a group of experienced science coordinators, from districts

of varying sizes, to share their insights as science coordinators and to help the participants with their strategic plan. These activities promote Goals 5 and 6.

Day 4, when they returned in the spring, began with small groups of participants sharing how they were progressing with their strategic plan by considering what was going well, what needed improvement, and components they need for the future. Afterward participants were provided an introduction to the basics of the NSTA Science Program Improvement Review (SPIR) tool to help with evaluation of their work. The participants completed the SPIR quiz as homework. The quiz results were discussed Day 5. This tool engages external reviewers and districts in assessing their program using a set of standards identified for high quality science programs (http://www.nsta.org/pd/spir/). This tool was selected as an example of the tools available for district analysis of science programs. The next three components, discourse, misconceptions, and nature of science, provided the opportunity for the coordinators to consider additional instructional strategies and supports for use in their districts. The focus of the classroom discourse session was to introduce the participants to key components of classroom discourse such as establishing norms, using talk prompts, and observing the prompts in use in teachers' classrooms. The book, *Ready, Set, Science!* (Michaels, S., Shouse, A.W., & Schwingruber, H.A, 2008) and materials *Science and Literacy: A Natural Fit - A Guide for Professional Development Leaders* (Worth, K., Winokur, J, & Crissman, S, 2009) were the foundation for this session. The misconceptions session focused upon strategies for identifying student misconceptions using materials such as *Uncovering Student Ideas in Science* by Keeley, Eberle, and others (2005-2012). The NOS session focused on strategies for explicit instruction on the aspects of NOS in the VA Standards of Learning. The day finished with an update presentation by the State Science Supervisor. These activities promote Goals 1, 2, 3, and 6.

Day 5 began with the introduction of a protocol for analyzing student work. The participants requested this professional development approach at the end of Day 3 in the fall. The participants examined several different protocols and then practiced using a common set of work and work that they brought with them from their districts. A session on the development of curriculum followed the student work analysis session. The participants looked at their curriculum guides and were provided analysis prompts that had them map their curriculum to determine whether it was aligned to the SOLs and supported instruction and assessment. Next, the participants revisited inquiry by examining a tool developed by Volkman and Abell (2003) to convert cookbook labs into inquiry labs. The last session of the day dealt with the evaluation of strategic plans and professional development using the SPIR results and the introduction of Thomas Guskey's book *Evaluating Professional Development* (1999). The participants completed an evaluation survey by the outside evaluator and returned home. These activities promote Goals 1 through 6.

Methods

Participants

Fifteen individuals attended the second NSCA. The participants included five males and ten females ranging in age from 28 to 59 years of age from 12 different school districts in Virginia. There were threeAfrican3 African American and 12 Caucasian participants. All of the participants hold a M.Ed. or M.S. degree and five participants hold or are in the process of earning an Ed.D. or Ph.D. in Education. All participants are currently in leadership positions in their respective school divisions (K-12 science coordinator, science lead teacher, science specialist, instructional coach, vertical team leader, beginning teacher advisor coordinator, elementary principal) and all of the participants have led science professional development.

Participants' years of experience in their current leadership role range from two months to 13 years with an average of 4.7 years of experience.

Measures

For this paper, we collected four types of data, participant exit slips, demographic data, agenda and handouts, and participant activity logs. The daily exit slips were developed by the VISTA NSCA implementation team to align with the goals of the NSCA. The questions on the daily exit slips asked participants to reflect on the sessions presented each day, to link their learning to their work, and to track the impact of the sessions. The responses were examined to determine the impact of the NSCA on their work. Grounded theory drove the determination of themes/categories from the participant reflections (Glaser & Strauss, 1967). The exit slips were read several times. Then, each question was read and responses were categorized by emergent themes (Creswell, 2012). Next, a comparison of the themes to the NSCA goals for alignment occurred. Finally, the themes and their alignment to the goals allowed us to develop answers to the research questions.

The participant logs were participant self-reports of their activities outside of the academy that involved using their new understandings and resources, and their continued efforts on their strategic plans. These activities were conducted after normal work hours so the VISTA was able to provide a stipend for their work during the academy and outside the academy. These logs were analyzed using the same strategies described for the exit slips. The analysis allowed us to learn from the participants the extent to which the science coordinators used their new knowledge in their district work and to answer research question five.

Artifacts such as the agenda and handouts from daily activities were collected. In order to analyze if the goals were met, the agenda was correlated with the activities that were conducted, exit slips, and the goals.

Results/Findings

Findings for the various measures will be discussed in this section with implications for the findings discussed in the next section.

The participants have a variety of titles describing their roles in their districts. The list below shows the range of titles from district level positions to school level positions in small districts with limited district office personnel (Table 2).

Table 2
Position Titles of Participants

Science Specialist
Supervisor of Science and Visual Arts
Program Administrator/Instructional Supervisor
Science Teacher Specialist
Science Coordinator
Coordinator of Science
Math and Science Instructional Specialist
K-12 Science Coordinator
Elementary Science Coordinator
STEM Coordinator
Elementary Science Coach
Program Specialist--- Dept. of Curriculum & Instruction
Program Specialist - Secondary Science
Secondary Math/Science Lead Teacher
Science Department Chair

To better understand their role in their district, we asked the participants on Day one to describe the impact they have on science instruction in their districts. The predominant responses were professional and staff development, working directly with teachers, and curriculum development (see Table 3). These responses reflect the duties expected of someone in a district role as science leader.

Table 3
Potential Impact on Science Instruction in District (n= 15participants responding)

Role of participant in the school district	**Number of responses**
Professional and Staff development	10
Work directly w/teachers	9
Curriculum development	6
Instructional coaching	4
Work directly w/administrators	3
Ordering supplies & textbooks	2
Hiring and recruitment	2
Teacher evaluations	2
Teach in the classroom	2
Work w/ supervisors	1
School improvement planning	1
Creating shared mission and goals	1
Vague or unclear	3

Daily Exit Slips

Insight into the impact of the Academy from the participant's perspective follows.

Day 1. The design of day one of the Academy was to provide the participants with an introduction to VISTA, a discussion of their role as science leaders, and participation in a simulation which allowed the participants to consider the various factors within a school district impacting student learning. The simulation, *Building Systems for Science Literacy* from WestEd, was used to examine the various factors within the district that can impact student achievement. This simulation provided a common learning experience for the group and framed the work for the next four days. The participants' reflections on the simulation indicate that the simulation was very beneficial to their learning. Participants were asked to respond to how they will implement new science programs, how they will handle resistance to change, and how the simulation helped them understand the process of change. Three responses standout as exemplar responses for the group:

- "Developing a sense of community goes a long way. So does celebrating success and hearing everyone's voice and seeing needs. The game told me to build a foundation and community before attempting change."
- "I think one of the greatest pieces to the game was using a cohort of people to make informed decisions for the district. Putting time and energy on the front end is extremely important. I will gradually move those that are resistant along through tailored professional development for their needs."
- "I will be more aware not to offer 'one size fits all' professional development experiences. The simulation game helped me focus on ways to motivate reluctant teacher learners and the importance of creating or developing teacher leaders."

These responses indicate that participants learned and/or took away the key goals and outcomes of the simulation. Tables 4 and 5, organized into themes and number of similar responses, provide further insight into the overall benefits of the simulation for the participants. Some goals of the simulation resonated more strongly with participants than other goals, such as gaining buy-in and needing to know staff needs, and providing adequate time and support for sustained professional development.

Table 4
Implementing New Programs and Dealing with Individuals Not Liking Change (n=15 participants responding)

Themes	**Number of Responses**
Create buy-in	8
Engage teachers in professional development	6
Invest in research and planning	4
Build collaborative groups	2
Build community/relationships	2
No clear answer to this part of the question	2
Evaluate and monitor progress	1

Build in sustainability opportunities	1
Build in rewards and incentives	1

Table 5
Simulation Help with Understanding Change (n=15 participants responding)

Themes	**Number of Responses**
No clear answer to this part of the question	4
Making informed decisions	2
Gaining buy-in	2
Changes in practice	2
"Ike"	1
Enjoyed the simulation	1
Planning professional development	1
Building community	1
Creating awareness (unspecified)	1
Building awareness ("interests and thoughts of folks")	1
Involving individuals in visualization and frameworks	1
Creating or developing teacher-leaders	1

Day 2. Day two focused on recognizing and assessing quality teaching, using available data for planning, and introducing to strategic planning. The exit slip focused on the first two areas. To determine participant understanding of the sessions focused on recognizing and assessing quality-teaching time, the participants were asked to select one term, hands-on, inquiry, or problem-based learning, from the day's discussion to elaborate upon (Table 6). A participant's definition was compared to the definition used by VISTA. Also, the participants' indicated their reasons for selecting their term, and how they envisioned improving their efforts to assist teachers in their practice. The participants' definitions aligned fully or in part with those of VISTA. Their reasons for selecting terms to define ranged from their personal and their

districts' needs to fostering 21st century skills. Their strategies for assisting teachers in their practice ranged from professional development to embedding in curriculum.

Table 6
Use of the term: Hands-On (n= 5 participants responding)

Definition	**Number of Responses**		**Reason**	**Number of Responses**		**Use in practice**	**Number of Responses**
Full alignment	5		Identified need at site	2		"Teaching teachers"	2
Partial	0		Most familiar of the three	2		Professional Development	1
Not aligned	0		Least familiar of the three	1		Increase student involvement	1
			Desires to become an expert	1			

Use of the term: Inquiry (n= 4 participants responding)

Definition	**Number of Responses**		**Reason**	**Number of Responses**		**Use in practice**	**Number of Responses**
Full alignment	2		Identified area of weakness at site	2		Assist teachers in skills development	1
Partial	2		Feel comfortable, already use this	1		Use as a tool for evaluation and feedback	1
Not aligned	0		Previous encounter with idea	1		Professional Development	1
						Meetings with teachers	1
						Incorporate into district philosophy (mission)	1

Use of the term: Problem-Based Learning (n= 4 participants responding)

Definition	Number of Responses		Reason	Number of Responses		Use in practice	Number of Responses
Full alignment	2		Actively trying to build this skill currently	1		Develop curriculum (lessons and units)	2
Partial	2		STEM focus	1		No answer	2
Not aligned	0		Potential for student motivation	1			
			Fosters 21st century skills	1			
			Relevance is important	1			
			No reason	1			

The second focal area for Day two was on the use of data by teachers to understand student thinking and to plan their science instruction. Participants responded to this question by considering their role and needs in their districts and by addressing the needs of teachers (Table 7). One participant shared that examining student data and other assessments was common practice by his teachers. One participant summarized all of the responses when she said:

> "The data can unveil gaps in the curriculum, the instructional practices, and lesson plans that must be improved in order to improve/increase student achievement. The data should drive all instructional aspects."

Table 7
Use of Data in Understanding Student Thinking and Planning Instruction (n= 13 participants responding)

Themes for Use of Data by District Administrators	Themes for Use of Data by Teachers
Provide teachers with appropriate strategies for	Drive instruction (2 responses)

use	
Broader view, specific insight	World rankings (4 responses)
Big picture for decision-making (2 responses)	Access, review and discuss
Planning and Budgeting	Understand achievement gaps (2)
Plans for improvement	Reflecting and Improving/ Raise rigor and expectations
Don't know	Identify trends and weaknesses/areas of challenge
	Develop best practices
	Identify curricular weaknesses

Day 3. During Day three, participants focused on developing an action and strategic plan. At the end of the day, they shared what steps in these planning processes they were comfortable with, where they needed help, and one major priority for their plan now that they have an understanding of strategic planning. Some participants were comfortable with specific components, such as "identifying the strengths and weaknesses as well as possible opportunities in their districts", while others were comfortable with all components. Listed in Table 8 are other components with which participants were comfortable. Only five participants indicated areas of need at this time. Their needs ranged from needing access to additional research and data to needing help with data protocols and following up with their elementary teachers (Table 8). The participants also had a range of priorities based on their needs and those of their districts. These priorities focused on planning professional development, working on specific areas such as nature of science, building teacher buy-in, and gaining buy-in from district leadership (Table 8).

Table 8

Action and Strategic Plans: Comfort, Help, Priorities (n= 12 participant responses)

Comfortable with	**Need help with**	**Major priority**
Identifying strengths & weaknesses in their districts	Unaware /No answer (7 responses)	Include plans for professional development (2 responses)
Identifying opportunities in their districts	Needed to spend more time at the conference	Engage teachers in building science literacy and help for working with English Language Learners
Involving collaboration in the planning process	Need access to additional research	Plan to address threats to student achievement
All of the steps (2 responses)	Need help with data protocols	Include building buy-in among leadership
Identifying areas of concern	Need additional data sources	Include training in nature of science (2 responses)
Identifying resources	Need to follow up with elementary schools on Nature of Science and Inquiry	Include building buy-in among teachers
Building a plan based on the structure provided		Include science in division plans
Meeting with the director		Build a vision for science with teachers
Outlining the steps for the planutliningthe steps		Build a common vision and mission
Working through the data		Include the needs of new Secondary Science teachers
No answer (3 responses)		

During this day of action and strategic planning, a panel of experienced science coordinators from around the state shared their experiences and answered questions posed by these new district science leaders. The participants reflected on the discussion to identify insights gained from the coordinators about their work and to identify questions they still had for them and other coordinators (Table 9). Several insights indicate the range and depth of of the participants' learning.

- "It takes a long time to implement a program or change a program."
- "I learned that large districts operate a lot differently than smaller districts and would like to learn more about their curricula K-12."

- "It's interesting how we are all so different, yet (have) many of the same challenges."

This last quote exemplifies the feeling of over half of the participants as they were surprised by the similarity in obstacles and challenges. This served as a unifying point for all of the participants.

Table 9
Science Coordinator Panel Discussion: Insights and Questions (n= 12 participant responses)

Theme: Insights	**Theme: Questions for others**
Sharing obstacles/similar issues (7 responses)	How do large districts work and what does their curricula look like?
Importance of our job (2 responses)	How do large districts manage their time?
Needs of different size divisions (2 responses)	How are other districts incorporating NOS in the classroom?
ong time for change or adoption of new programs	No question written (9 responses)
Work is a balancing act	
Need for action, from the very beginning	
Different districts have different clientele	
Great resources in the network of coordinators	
Need to get data and direction	
Change is easier in small districts	
How big this task will be	
We are not alone	

Day 4. At the beginning of day four, participants were asked to think back to our first three days in the fall and to share what new insights they had had since then about the program and what ideas they had taken back to use in their districts. The most common component of the program that participants continued to have insights about and to use was their learning and work with the VISTA definitions for Hands-on science, Inquiry, and the Nature of Science (NOS) (Table 10). Other insights focused on science education in the U.S., the need for focused, data-driven professional development, and implementation of inquiry and NOS in the classroom. The participants also had strategic planning as a focus, and used activities from the program, such as the "apple activity" which focuses on the definition of hands-on science. A

number of other ideas and program components were of value to other participants (see Table 10).

Table 10
Reflecting on Insights from Days 1 to 3 and on What They Have Used (n= 14 participant responses)

Themes for New Insights	Number of Responses		Themes for "What I have used?"	Number of Responses
Notable definitions: hands-on, NOS, inquiry	5		Conducted professional development on definitions (NOS, inquiry, hands-on)	8
Infrastructure of science educationin the U.S.	2		Used the "apple activity" - sharing the activity with new teachers	3
Need for focused, data driven professional development	2		Using strategic planning as a district focus	3
Implementing NOS and inquiry in the classroom	2		Creating a vision for incorporating inquiry	1
Role of myself as a science coordinator	1		Used the TIMSS data and websites	1
Assessing quality rather than quantity (what vs. how much)	1		Collecting baseline data for "hands-on" time	1
Planning in a division is harder than I thought	1		Building capacity of teachers and leaders	1
Importance of teacher knowledge base	1		Conducting vertical team meetings	1
Including obtainable goals in strategic plan	1		Developing an understanding of new standards	1
Scope of needs for science content instruction	1		Developing and implementing a needs assessment for the county	1

Days 4 and 5 focused upon strategic planning, the examination of several instructional strategies/approaches, and the analysis of student work. On day 4, participants had sessions on incorportation of classroom discourse, use of student misconceptions, and strategies for implementing the NOS in the classroom. They were asked to reflect these three, to select two they envisioned working on with their teachers, and explain why they selected those (Table 11). Participants selected discourse and misconceptions most frequently. Several participants

indicated that these two areas "merge at a point if our goal is to create a science-literate community." The NOS session introduced new strategies but had been discussed previously, so its impact may have been lessened.

Table 11
Day 4: Strategies Sessions (n= 14 participants responding)

Discourse	**Number of Responses**		**NOS**	**Number of Responses**		**Misconceptions**	**Number of Responses**
Selected as one of two sessions to talk about	*12*		*Selected as one of two sessions to talk about*	*5*		*Selected as one of two sessions to talk about*	*9*
Ease of integration	3		Ease of integration	3		Importance to learning	2
Similar to what they know	1		Importance to learning	1		Similar to what they know	1
Need to decrease teacher talk	1					Ease of integration	1
Value in the classroom	1						

The participants also shared how they planned to use these with teachers. They felt the discourse session would help promote a literate community and the question prompts provided a framework for the introduction and support of student talk. The participants envisioned "going over" and "helping out teachers" with the different aspects of the nature of science. The participants planned to share both the misconceptions web resources and *American Association for the Advancement of Science* assessment items correlated to misconceptions (http://assessment.aaas.org/) with their teachers.

Day 5. Day five focused on strategic planning, curriculum design at the district level, analysis of student work by teacher groups, and revisiting inquiry. Participants were asked to

select two of the three sessions which had the greatest impact on them and how they envisioned using the information in their districts. The participants felt the sessions were equal in impact. (Table 12). Some felt they were comfortable with inquiry so the focus on student work and curriculum was more significant for them. They found that all three sessions filled a need in their district and were relevant to their work in their districts.

Table 12
Day 5: Strategy Sessions (n= 11 participant responses)

Analyzing Student Work	**Number of Responses**		**Curriculum**	**Number of Responses**		**Inquiry**	**Number of Responses**
Selected as one of two sessions to talk about	*8*		*Selected as one of two sessions to talk about*	*7*		*Selected as one of two sessions to talk about*	*6*
Value of activity to meeting objectives	1		Identified need by teachers	4		Relevance to district needs	2
Identified need for improving student learning outcomes	1		Process would help with teachers teach beyond the SOLs	1		Identified need by teachers	1
Direct impact on teaching	1		Relevance to district needs	1		*Already knew this*	1
						Direct impact on teaching	1

The participants envisioned using each session in different ways with professional development and furthering discourse/discussion on strategies to improve student achievement (Table 13).

Table 13
Themes for envisioning the use of these sessions (n= 11 participant responses)

Analyzing student work	**Curriculum**	**Inquiry**
Further the discourse on the secondary level	Conduct professional development in the district	Conduct professional development
Focus teacher meetings on this	Help improve student	Further the discourse on the

	achievement	secondary level
Helps align to SOLs and Bloom's		Focus meetings on this
Improve student achievement		Helps align to SOLs and Bloom's

The participants reflected on the strategic planning process over the entire academy. They were asked to describe how they envisioned their plan helping them with their district work. The two themes identified more than once were the plan would provide focus and future direction, and the plan would help to "overhaul the curriculum in the district" (Table 14).

Table 14
Themes for envisioning how the strategic plan will help their work (n= 11 participants responding)

Themes	**Number of Responses**
Focus and direction	4
Total overhaul to curriculum	2
Bringing BIG IDEAS back	1
Contacts/networking	1
Resources from NSCA	1
Redesign of professional development	1
Stronger emphasis on NOS	1
Thinking about it as a tool	1
Possibly establish plan next year	1

At the end of Day five, participants reflected on the program to identify non-applicable components of the program, to pose questions they still had, and to make suggestions for the future. The majority of the participants felt all of the program components were applicable to their work in their districts. Several suggestions were made (Table 15) that the faculty will take into consideration. The participants had only a couple of questions for the faculty (Table 16) and made several suggestions for future academies (Table 17) such as more time for them to talk

about their programs, more communication from the faculty, and suggestions for working with principals.

Table 15
Themes for Non-applicable components (n= 11 participants responding)

Themes	Number of Responses
None- all were applicable	8
Slight changes: tweak to be appropriate for coordinators rather than teachers	1
Professional Development section – no resources or ability to do this right now	1
Training – I am not in charge of training	1

Table 16
Themes for Remaining questions (n= 11 participants responding)

Themes	Number of Responses
No questions at this time	7
How can I do everything? , I need help prioritizing, help from teachers	1
If I don't see results, what next?	1
What are other systems doing?	1
More info on developing curriculum	1

Table 17
Themes for Suggestions for the Future (n= 11 participants responding)

Themes	Number of Responses
More "talk" time for coordinators to share key issues and struggles	2
More communication throughout the year from VISTA staff	1
Job functions	1
Working with principals	1
How to develop/write curriculum	1

Activity Logs

To earn a stipend, participants had to document at least 40 hours of work across the year related to their job and the Academy, but outside of their normal working hours. To document their work, the participants provided a log of their activities outside of the five days in the academy that indicated their use of ideas from the Academy. The participants reported from 40 to 56.5 hours of work outside of the academy and their normal work. On average, participants reported 46 hours of work related to the academy. The coordinators impacted from 32 to 2460 teachers (avg of 490 teachers) and from 136 to 1700 students (avg of 1100). While these hours and impact on teachers and students were reported to receive a stipend, they provide insight into the components of the Academy that the participants valued or felt they needed to support their work. The participants reported reading from the resources provided, such as *Designing Professional Development for Teachers of Science and Mathematics* (2009) and *Ready, Set, SCIENCE!* (2007), incorporating activities used in the Academy into their professional development, and developing other types of professional development (Table 18).

Table 18
Summary of Log of Application of Learning (n= 11 participants responding)

Session	**Resource**	**Number of Participants**
Leadership – Leading School-Based PD: Building Capacity for Science Learning Simulation	Reading of: PD Design Framework Ready, Set Science	 3 2
Leadership – Recognizing and Assessing Quality Teaching Instruments - Hands-on Science, Inquiry, PBL, NOS Revisiting Inquiry	Professional Development incorporating: - Hands-on Science - Inquiry-based Science	 5 7 2

NARST Conference 2013, Strand 8: In-service Science Teacher Education, VISTA- Second Year Statewide Implementation

	- Problem-based Learning - Nature of Science	9
Leadership Planning – Your School Division- Data	Activities continued: - Data Analysis - Use of Data Websites	1 4
Strategic Plan for Science	Development of plan continued	9
Professional Development Planning and Sharing	Development of professional development sessions and delivery to district teachers	11

Correlation of Goals to Professional Development and Evaluation

The NSCA has six goals for participants (see page 11). A correlation of academy goals to sessions conducted each day and to exit slip questions can be found in Appendix B. Examining the themes identified from the daily exit slip questions identified in Appendix B allowed us to assess whether the NSCA achieved each goal.

For goal one, *improvements in leadership, teacher learning, quality teaching, and student learning*, themes that emerged are:

- Teacher buy-in and professional development are essential for these to happen.
- Collaboration and building community support these improvements.
- VISTA definitions for Inquiry, Hands-on science, and Problem-based learning support these improvements. Needs are different at each district and personally for the science coordinators. They envision using these ideas in professional development, as a feedback tool for classroom observations, and to develop curriculum. These definitions are providing the coordinators with a support structure for working with teachers.

- Classroom discourse strategies, identification and use of student misconceptions are important components for making these improvements.
- Analyzing student work and the development of curriculum by teachers are important strategies for helping districts improve.

For goal two, *developing a common understanding of hands-on science, inquiry, problem-based learning, and nature of science*, themes that emerged are:

- As indicated for goal 1, the sessions focused on the VISTA definitions for Inquiry, Hands-on science, and Problem-based learning supported their development of a common understanding.
- Some of the participants are less familiar with these terms than others, so the sessions helped develop understanding.
- The definitions support their district work in STEM and 21st Century Skills.
- These definitions are providing the coordinators with a support structure for working with teachers.

For goal three, *identifying aspects of effective science teaching and learning*, themes that emerged from these sessions include:

- Professional development and collaboration are important for a common vision to develop.
- The VISTA definitions provide support for teachers and themselves.
- The research observation tool is a useful tool for evaluation and feedback.
- Professional development focused on these definitions has occurred.
- Baseline data for "hands-on" is being collected.

- Classroom discourse is easy to integrate and decreases teacher talk.

For goal four, *comparing district models of creating standards-based science curricula*, themes that emerged from these sessions include:

- It is an identified need by district.
- Good curriculum helps teachers go beyond the VA Standards of Learning (SOLs).
- The strategy for analysis will be used in professional development.

For goal five, *investigating data sources available to use to provide a focus to improve district science programs*, themes that emerged from these sessions include:

- Data help to identify gaps in instruction and assist with decision-making.
- Data will help determine which strategies are most effective.
- Data can help teachers "raise the rigor and expectations."
- There is a need for focused, data-driven professional development.

For goal six, *developing a science program strategic plan*, themes that emerged from these sessions include:

- Participants were comfortable with identifying district strengths and weaknesses.
- Most participants felt they did not need additional help with the process of developing a strategic planning. A couple of participants indicated needing help with data sources and data protocols, accessing research to support their plans, and following up with schools in the areas of inquiry and nature of science.
- Strategic Plan priorities varied based on the needs of each participant and their district. Some of the priorities include: planning for professional development in general, planning for nature of science professional development, science literacy for all

students, addressing threats to student achievement, building a common science vision among teachers, and several others.

An examination of the themes identified from the participant responses allowed for answers to the research questions guiding this study. We used each question as the lens for reviewing and selecting themes. The questions guiding the study of the impact of NSCA are:

1) To what extent do the science coordinators gain knowledge about each of the NSCA goals during the five-day NSCA?

2) Which goals of the NSCA were viewed as most beneficial to the science coordinators?

3) What needs do the science coordinators express to facilitators that are not met by the NSCA?

4) To what extent do the science coordinators use the new knowledge in their district work?

For question 1, the extent to which the coordinators gained new knowledge about each of the goals, it is important to remember that the coordinators came to the NSCA with a wide range of prior experiences. Their reflections, as shared in tables 2 through 18, indicate that they learned from the activities designed to match each aim/goal of the NSCA. The insights took many forms, from learning new information to considering new perspectives. Overall, the science coordinators gained new knowledge from the NSCA.

For question 2, which goals were most beneficial, it is difficult to determine from this data whether one component was more beneficial than another component. The various backgrounds of the coordinators resulted in different components resonating more strongly with them. All of the aims/goals in some way improved participants'understanding or reminded them

of the importance of considering all of the ideas or components presented as they build their programs.

For question 3, needs not addressed by the facilitators, the science coordinators were very honest about areas in which they need help. These include areas such as "additional research to support their goals," "needing data protocols for working with data and their teachers," "if I don't see results, what next?," "more on developing curriculum," and "more information on how other districts work."

The answer to question 4, the extent of participant learning used by them back in their district, is informed by the data logs the participants submitted at the end of the spring (Table 18). These logs indicate that the participants read and used the publications shared with them. They incorporated some of the activities into their own professional development with teachers, incorporated the VISTA definitions in professional development, and continued working to analyze data and develop their strategic plan. In conversations with the coordinators at the Virginia Science Education Leadership Association and Virginia Association of Science Teachers 2012 conferences, the coordinators reiterated that the NSCA was beneficial to their work. They sat and planned together during these meetings and shared that they continued to use the tools and ideas shared at the Academy (Elizabeth Edmondson, personal communication).

Discussion and Limitations

Research on the learning of science coordinators and their impact on the teaching and learning of science in their districts is very limited. This is unfortunate, as they can play a critical role in how the district views the teaching of science; how science instructional materials are developed, selected and implemented; and the instructional practices teachers learn about, are encouraged to use, and feel supported in their efforts to implement.

This second NSCA provided an opportunity for participants to build a network with other science leaders across the state, build a common vision for science instruction, and obtain tools to support their work back in their districts. Participant reflections indicate that they learned from their experiences and intent to use this knowledge. Overall, the reflections indicate that the NSCA successfully addressed its goals and met the needs of the participants. The reflections also indicate that all participants believe the tools and support of the group to be important to their work.

The participants came to the Academy with diverse prior experiences and diverse roles and responsibilities as science leaders. The components of the Academy were important to all participants and it is no surprise that different components of the program resonated more strongly with some participants than with others. The diverse program allowed participants to enter successfully from different places and to develop new understandings and skills for use in their positions. The simulation, *Building Systems for Science Literacy*, provided an important common experience allowing participants to consider their current understanding, to learn other participant strengths, and to begin building collegial networks.. The model PBL activity provided a common experience for the participants to discuss best instructional practices and consider their role in working with teachers to improve hands-on inquiry-based science instruction. The development of individual strategic plans allowed participants to meet their needs and the needs of their district. These different components support the needs of these learners as they provide multiple entry points and opportunities to grow (Bransford et al., 2000; Stiles & Mundry, 2002; Thompson and Zeuli, 1999). The skills and opportunities provided in the NSCA align with the strategies (Bottoms, 2010), dimensions (Honig et.al., 2010), and components (Louis et. al., 2010) identified and shared in the literature review. The activities of

the NSCA should help the participants take on a role within their district that impacts teacher practice and student learning.

This study's strong linkage among the agenda, goals, activities, and daily evaluation strongly suggests well-planned professional development. Eight of 11 (73%) of the participant thought that all components of the program were applicable. In addition, the responses by the participants of their comfort with the program, not needing further help, and all have used aspects of the program further suggests the effectiveness of the professional development for the coordinators.

An innovative aspect of the program was to provide further planning, in addition to the planning during the academy, by providing a stipend for the participants to create and implement professional development. This aspect of the program seems to be an effective method of having the participants carry through with the intent of the academy to increase effective professional development for teachers.

This study faces several limitations. First, the sample size is small (N=15). The data available for analysis (Participant Reflections and Logs) is limited but does provide insight into participant perceptions. In the future, responses from multiple years will allow for more reliability as to perceptions and use in the short term in participant work. Additional study of how the participants continue to use their learning is needed. The ability to track these individuals is essential, as it will provide science educators insight into the impact of the Academy on their role as district leaders and the impact they have on student learning.

The overall purpose of this Academy, as identified in the grant proposal, is to support the development of the state infrastructure necessary to bring improvement to classroom instruction and student achievement. The data shared in this paper support this purpose as the Academy

provided learning opportunities for new science coordinators and they left with new insights matching their needs. . Future studies need to consider their impact on classroom instruction and student achievement.

References

Anderson, S.E. (2003). The school district in educational change: A review of the literature. ICEC Working Paper #2.

Banilower, E. R., Boyd, S. E., Pasley, J. D., & Weiss, I. R. (2006). *Lessons from a decade of mathematics and science reform: A capstone report for the local systemic change through teacher enhancement initiative.* Unpublished manuscript, Horizon Research, Inc.

Bottoms, G. & Schmidt-Davis, J. (2010). The three essentials: Improving schools requires district vision, district and state support, and principal leadership. Atlanta, GA: Southern Regional Education Board.

Bransford, J. D., Brown, A. L., & Cocking, R. R., eds. (2000). *How people learn: Brain, mind, experience, and school, Expanded Ed.*. Washington, DC: The National Academies Press.

Copland, M. A., & Knapp, M. S. (2006). *Connecting leadership with learning: A framework for reflection, planning and action.* Alexandria, VA: Association for Supervision and Curriculum Development.

Creswell, J. (2012). *Educational Research: Planning, Conducting, and Evaluating Quantitative and Qualitative Research*. Boston: Pearson.

Floden, R., E., Porter, A. C., Alford, L. E., Freeman, D. J., Susan, I., Schmidt, W. H., & Schwille, J.R. (1988). *Instructional leadership at the district level: A closer look at autonomy and control*. Educational Administration Quarterly, 24(2), 96-124.

Fuhrman, S.H. & Elmore, R. F. (1990). Understanding local control in the wake of state education reform. Educational Evaluation and Policy Analysis. 12(1), 82-96.

Glaser, B. G., & Strauss, A. (1967) *Discovery of grounded theory. Strategies for qualitative research*. Mill Valley, CA: Sociology Press.

Guskey, T. R. (2000). *Evaluating Professional Development.* Thousand Oaks, CA: Corwin Press, Inc.

Honig, M. I. (2006). Street-level bureaucracy revisited: Frontline district central office administrators as boundary spanners in education policy implementation. *Educational Evaluation and Policy Analysis, 28*(4), 357–383.

Honig, M.I., Copland, M.A., Rainey, L., Lorton, J.A., & Newton, M. (2010). *School district central office transformation for teaching and learning improvement. A report to the Wallace Foundation*. Seattle, WA: The Center for the Study of Teaching and Policy.

Honig, M.I. (2012). *District Central Office Leadership as Teaching: How Central Office Administrators Support Principals' Development as Instructional Leaders.* Educational Administration Quarterly, 48(4), 733-774.

Institute of Education Sciences. (2012). Highlights From TIMSS 2011: Mathematics and Science Achievement of U.S. Fourth- and Eighth-Grade Students in an International Context. Washington, DC. Retrieved on December 15, 2012 from http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2013009.

Keeley, P., Eberle, F., Farrin, L. (2005-2012). Uncovering student ideas in science: 25 formative probes (various volumes). Arlington, VA: NSTA Press.

Leithwood, K., Louis, K., Anderson, S. & Wahlstrom, K. (2004). *Review of Research: How leadership influences student learning.* A report to the Wallace Foundation. Seattle, WA: The Center for the Study of Teaching and Policy.

Levy, A., Pasquale, M., & Marco, L. (2008). Models of providing science instruction in the

elementary grades: A research agenda to inform decision makers. *Science Educator*, 17(2), 1-18.

Loucks-Horsley, S., Stiles, K. E. , Mundry, S., Love, N., & Hewson, P. W. (2009). *Designing professional development for teachers of science and mathematics.* Thousand Oaks, CA: Corwin Press, Inc.

Louis, K., Leithwood, K., Wahlstrom, K., & Anderson, S. (2010). *Investigating the links to improved student learning. Final report of research findings.* A report to the Wallace Foundation. Seattle, WA: The Center for the Study of Teaching and Policy.

Marsh, J. (2002). How districts relate to states, schools, and communities: A review of emerging literature. In A. Hightower, M., Knapp, M. J. Marsh, & M. McLaughlin (Eds.), *School districts and instructional renewal* (pp. 25-40). New York, NY: Teachers College.

Marsh, J.A., Kerr, K.A. Ikemoto, G., Darilek, H., Suttorp, M.J., Zimmer, R.W., & Barney, H. (2005). *Advancing system-wide instructional reform: Lessons from three urban districts partnered with the Institute for Learning*. Rand Education Press.

Mac Iver, M., & Farley, E. (2003). *Bringing the district back in: The role of the central office in improving instruction and student achievement.* CRESPAR Report #65. Baltimore, MD and Washington, DC: Center for Research on the Education of Students Placed at Risk.

McLaughlin, M.W. & Talbert, J.E. (2003). Reforming districts: How districts support school reform. Seattle, WA: Center for the Study of Teaching and Policy.

Miller, C.L. (2010). District leadership for science education: Using K-12 departments to support elementary science education under NCLB. *Science Educator,* 19(2), 22-30.

Michaels, S., Shouse, A. W., Schweingruber, H.A.. (2007). *Ready, Set, SCIENCE!: Putting Research to Work in K-8 Science Classrooms*. Washington, DC: The National Academies Press.

National Research Council. (1996). *National Science Education Standards*. Washington, DC: The National Academies Press, 1996.

National Research Council. (2000). *Inquiry and the National Science Education Standards: A Guide for Teaching and Learning*. Washington, DC: The National Academies Press.

National Research Council. (2012). *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*. Washington, DC: The National Academies Press, 2012.

Playing for real: How a simulation game can improve professional development. (2009). *WestEd's R&D Alert*, 10(2), 18-20.

Rhoton, J. (2010). Science education leadership: Best practices for the new century. Washington, DC: National Science Teachers Association Press.

Rorrer, A.K. & Skrla, L. (2005). Leaders as policy mediators: The reconceptualization of accountability. *Theory into Practice*, 44(1), 53-62.

Rorrer, A. K., Skrla, L. & Scheurich, J. J. (2008). Districts as institutional actors in educational reform. *Educational Administration Quarterly*, 44(3), 307-358.

Sebastian, J. & Allensworth, E. (2012). The influence of principal leadership on classroom instruction and student learning: A study of mediated pathways to learning. *Educational Administration Quarterly*, 48(4), 626-663.

Spillane, J.P. (1996). School districts matter: Local educational authorities and state instructional policy. *Educational Policy*, 10(1), 63-87.

Spillane, J. P. (1998). State policy and the non-monolithic nature of the local school district: Organizational and professional considerations. *American Educational Research Journal, 35*(1), 33-63.

Spillane, J.P. & Callahan, K.A. (2000). Implementing state standards for science education: What district policy makers make of the hoopla. *Journal of Research in Science Teaching*, 37(5), 401-425.

Spillane, J. P. (2000) *District leaders' perceptions of teacher learning*. Philadelphia: Consortium for Policy Research in Education.

Spillane, J.P., Diamon, J.B., Walker, L.J., Halverson, R., & Jita, L. (2001). Urban school leadership for elementary science instruction: Identifying and activating resources in an undervalued school subject. Journal of Research in Science Teaching. 38(8), 918-940.

Science Program Improvement Review Tools (SPIR), National Science Teachers Association. Retrieved on March 15, 2011 from http://www.nsta.org/pd/spir/.

Stiles, K. & Mundry, S. (2002). Professional development and how teachers learn: Developing expert science teachers. In R. Bybee, (Ed.), *Learning science and the science of learning* (pp. 137 -151). Arlington: NSTA Press.

Thompson, C. L. & Zeuli, J. S. (1999). The frame and the tapestry. In L. Darling-Hammond and G Sykes, eds., *Teaching as the learning profession: Handbook of policy and practice*. San Francisco: Jossey-Bass.

Togneri, W. & Anderson, S.E. (2003). *Beyond islands of excellence: What districts can do to improve instruction and achievement in all schools*. Washington, D.C.: Learning First Alliance.

Wahlstrom, K.L., Louis, K.S., Leithwood, K., & Anderson, S. E. (2010). *Investigatingthe links to improved student learning, executive summary* (Commissioned by The Wallace

Foundation). Retrieved August 10, 2012 from http://www.wallacefoundation.org/knowledge-center/school-leadership/key-research/Documents/Investigating-the-Links-to-Improved-Student-Learning.pdf.

Worth, K., Winokur, J, & Crissman, S. (2009*). Science and literacy: A natural fit: A guide for professional development leaders.*Portsmouth, NH: Heinemann.

Appendix A

Agenda for Each Day

Day 1	Day 2	Day 3
UVA Data Collection Introduction of Staff Program Overview and Goals Brief introduction of VISTA Introduction to the Science Landscape in VA Introduction to VA Science Organizations and their Role as a Science Leader Leadership- Leading School-Based PD: Building Capacity for Science Learning through The Building Systems for Science Literacy Simulation (WestEd) The Building Systems Simulation Debrief Wrap up and Homework Exit Slip	Goals for the Day Leadership- Recognizing and Assessing Quality Teaching- engaging participants in a PBL lesson Definitions and Instruments- Hands-on Science, Inquiry, PBL, and the Nature of Science Leadership Planning- Your School Division and Data (TIMSS, NAEP, AAAS, and School Division Data) Strategic Planning for Science Wrap up and Homework Exit Slip	Goals for the Day Leadership Planning- Teacher Professional Development Interactive Roundtable Teacher Professional Development Planning and Consult with Experts Sharing Professional Development Plans Planning for Day 4 and 5 Wrap Up Exit Slip

Day 4	Day 5
Welcome Back Strategic Planning I Focusing on Effective Science Instruction: Classroom Discourse Focusing on Effective Science Instruction: Misconceptions Nature of Science Update from the State Wrap Up Exit Slip	Reflections Focusing on Effective Science Instruction: Analyzing Student Work Focusing on Effective Science Instruction: The Role of Curriculum Focusing on Effective Science Instruction: Inquiry II Strategic Planning II Wrap Up UVA Evaluation

Appendix B

Correlation of Goals to Academy Sessions

For goal 1, improvements in leadership, teacher learning, quality teaching, and student learning, the following sessions and exit slip questions addressed this goal:

Daily Sessions Correlated to this Goal	Exit Slip Questions Correlated to this Goal
Day 1: *Building Systems for Science Literacy* simulation from WestEd Day 2: Update from State, Recognizing and Assessing Quality Teaching (State and District Data) and Strategic Planning, Day 3: Teacher Professional Development Planning and Sharing of Plans and Expert Panel, Day 4: Strategic Planning I and Update from State, Discourse, Misconceptions, Nature of Science Day 5: Strategic Planning II and Curriculum. Analyzing Student Work, Inquiry, Curriculum	Day 1 Question 1 and 2 Day 2 Question 1 Day 4 Question 1 and 2 Day 5 Question 1

For goal 2, developing a common understanding of hands-on science, inquiry, problem-based learning, and nature of science, the following sessions and exit slip questions addressed this goal:

Daily Sessions Correlated to this Goal	Exit Slip Questions Correlated to this Goal
Day 2 VISTA Definitions and Instruments Day 4 Nature of Science (NOS) Day 5 Analyzing Student Work and Inquiry	Day 2 Question 1 Day 4 Question 1 Day 5 Question 1

For goal 3, identifying aspects of effective science teaching and learning, the following sessions and exit slip questions addressed this goal:

Daily Sessions Correlated to this Goal	Exit Slip Questions Correlated to this Goal
Day 1: *Building Systems for Science Literacy* simulation from WestEd Day 2 VISTA Definitions and Instruments, Day 4 Discourse, Misconceptions, NOS, Day 5 Analyzing Student Work, Inquiry, Curriculum	Day 1 Question 2 Day 2 Question 1 Day4 Question 1 and 2 Day 5 Question 1

For goal 4, comparing district models of creating standards-based science curricula, the following sessions and exit slip questions addressed this goal:

Daily Sessions Correlated to this Goal	Exit Slip Questions Correlated to this Goal
Day 5 Curriculum	Day 5 Question 1

For goal 5, investigating data sources available to use to provide a focus to improve district science programs, the following sessions and exit slip questions addressed this goal:

Daily Sessions Correlated to this Goal	Exit Slip Questions Correlated to this Goal
Day 2 Recognizing and Assessing Quality Teaching (State and District Data)	Day 2 Question 2 Day 4 Question 1

For goal 6, developing a science program strategic plan, the following sessions and exit slip questions addressed this goal:

Daily Sessions Correlated to this Goal	Exit Slip Questions Correlated to this Goal
Day 2 Recognizing and Assessing Quality Teaching (State and District Data), Strategic Plan, Day 3 Teacher Professional Development Planning,	Day 3 Question 1 and 2 Day 5 Question 2

Day 3 Sharing of Plans and Expert Panel, Day 4 Strategic Planning I, Day 5 Strategic Planning II	