A Foundational Study of the District Science Coordinators' Role in Supporting Science Instruction

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Abstract

This convergent parallel mixed-methods study explored the professional responsibilities of district science coordinators, their professional development (PD), and the relationship between their role, responsibilities, district context, and background. The national sample that completed the validated Science Coordinator Role Survey included 122 members of the National Science Education Leadership Association self-identified as science coordinators. The survey included demographic questions and questions about their responsibilities and professional growth. Participants' responses were analyzed using descriptive and correlational statistics. Open-ended responses were analyzed using a constant-comparative approach. Following analysis of survey data, 15 participants (12.3%) were purposefully selected for semi-structured follow-up interviews. Results indicated the majority of respondents identified themselves as Caucasian, female, and had served in their position for less than 10 years. The typical science coordinator held a degree in a science content-area and was a former science teacher. Most (92%) reported wanting additional science coordinator-focused PD. Additionally, correlations indicated respondents without science degrees held positions at small, remote, or rural school districts and were also likely to be responsible for multiple content areas including science. Alternatively, respondents working in large urban school districts tended to have science backgrounds, had more professional responsibilities, and were less likely to be responsible for multiple content areas. In interviews, science coordinators reported on the variety of barriers they encountered in supporting teachers and the difficulty they experienced in their positions. The results of this investigation further define the professional responsibilities of coordinators, provide insight into the role of a science coordinator, and specify the prevalent types and focus of PD desired by science coordinators.

Introduction

School districts, the primary providers of teacher professional development (PD) in the United States, spend billions of dollars on PD for their teachers each year (Birman et al., 2007; Pianta, 2011; Spillane, 2002), and play a major role in improving teaching and learning (Corcoran, Fuhrman & Belcher, 2001). School districts implement a variety of PD for teachers including: administrator and curriculum coordinator-directed PD, employing outside companies, creating professional learning communities for teachers, and partnering with universities and organizations. District leaders (i.e. staff developers, mentor teachers, science coordinators, math coordinators, testing coordinators, etc.) are closely tied to a district's effectiveness in improving teaching and learning (Firestone, Mangin, Martinez & Plovsky, 2005; Leithwood, Seashore-

Louis, Anderson & Wahlstrom, 2004; Marsh, 2002) and help shape the leadership a district provides (Ogawa & Bossert, 1995). However, little research examines the roles of these district leaders or how to support and educate leaders who provide PD to teachers under their supervision (Higgins, 2008; Luft & Hewson, 2014; Whitworth & Chiu, 2015). The present investigation seeks to address this gap by describing the role of school district leadership across the United States, specifically understanding the professional responsibilities of science coordinators and how they currently take advantage of opportunities to develop professionally.

Literature Review

This literature review begins with brief outline of what is known about effective professional development, then describes the research on science coordinators, illustrating their importance but the limited research focused on these leaders.

Effective Professional Development

Effective PD is characterized by active learning, coherence, collective participation, content focus, and duration (Desimone, 2009; Loucks-Horseley & Matsumoto, 1999; Luft & Hewson, 2014; Whitworth & Chiu, 2015). For teacher growth to occur, teachers should be actively engaged in their learning, which can occur through a variety of strategies, including practice teaching, planning, presenting, and reviewing student work (Desimone, 2009; Heller, Daehler, Wong, Shinohara, & Miratrix, 2012). PD should also be incorporated into a program of teacher learning that provides coherence with national, state, district, and school policies and standards (Desimone, 2009; Garet, Porter, Desimone, Birman, & Yoon, 2001). Furthermore, PD should allow for some level of collective participation, whether it includes teachers from the same school or department, or allows teachers from the same grade or subject area to work together (Desimone, 2009). Content-focused PD allows teachers the opportunity to develop their content knowledge and can lead to changes in teacher practices (Desimone, 2009; Garet et al., 2001). Finally, PD of a significant duration, meaning PD that it is spread out over time (e.g. a year or semester) appears to be more effective in changing teacher practices (Loucks-Horseley & Matsumoto, 1999; Pianta, 2011).

Despite the body of research on effective PD, district-offered PD for teachers is often ineffective and delivered in the format of short in-service workshops with little or no follow-up (Loucks-Horseley & Matsumoto, 1999; Pianta, 2011; Spillane, 2002). Furthermore, these "one shot" workshops often lack coherence or relevance for teachers (Spillane, 2002) and instead of being content-focused they address administrative, management, or discipline issues (Desimone, Smith & Phillips, 2007; Pianta, 2011). This disconnect between best practices in PD and what is actually implemented by district leaders suggests a need for further research to understand how the individuals who design and conduct PD are educated and supported (e.g., Luft & Hewson, 2014).

District Science Coordinators

District leadership in science includes subject-area supervisors and district science coordinators. In the present study, a district science coordinator is defined as an individual responsible for science curriculum and instruction within a district (e.g. Edmondson, Sterling, & Reid, 2012). Science coordinators usually hold at least a Master's of Education, are experienced in the classroom, and are most often the person responsible for overseeing science PD and the science curriculum (Edmondson et al., 2012). However, there exist many titles for those who serve in this role within a district (e.g. McComas, 1993). The present study focuses on research pertaining to the district science supervisor, science supervisor, and science coordinator roles.

Little research exists on science coordinators and the existing research is decades old. In one study, Perrine (1984) investigated how elementary teachers and science coordinators perceived the science supervisor position and its' practices. In his study, a sample of 29 coordinators and a random sample of 470 elementary teachers were surveyed in the state of New Jersey. Results indicated teachers and coordinators felt the present leadership behavior of the science coordinator was not ideal, and the science coordinator had different expectations than the actual supervisory practices. The author identified two components as critical to supervisory effectiveness: providing teachers with content and pedagogical supports and effective communication with teachers. The author called for the science coordinator role to be more clearly defined so all district stakeholders (e.g. principals, teachers, district administrators) could hold the same expectations for the position.

In another study, Madrazo and Hounshell (1987) investigated the perception of the science coordinator role by a variety of stakeholders in the state of North Carolina. Participants in the study included 23 superintendents, 23 science supervisors, 100 randomly selected principals, 208 elementary teachers, 208 secondary teachers, and 25 college professors. The Science Coordinator's Role Expectations Questionnaire was sent to the participants for completion and 89% of the population responded. Findings revealed the science coordinator role was perceived differently by different individuals. It was recommended that the role of the science coordinator be constantly evaluated in order to understand the different perceptions of this role and the changing attitudes of stakeholders. These results reinforced the importance of continuing to research the science coordinator role and endeavoring to define the role more clearly for all stakeholders.

A recent study suggests that district structure and background experience may play a role in the effectiveness of coordinators. Whitworth (2014), in a case study of three science coordinators, found that the coordinator with an elementary teaching background, responsible for students in grades PK-12, perceived she was less effective when working with secondary teachers. In contrast, the two coordinators with secondary teaching backgrounds and more science content expertise were perceived by teachers as effective across grade levels. Furthermore, science coordinators in smaller districts experienced barriers in finding the time and resources to support their teachers in improving science instruction. The results suggest districts may need to consider how to structure their administration and/or provide PD for leaders working with teachers outside of their content area or grade level expertise, as well as resources to support those coordinators working in smaller districts.

Together, the results of these investigations suggest district science coordinators play a role in supporting teacher instruction. Results indicate the importance of continuing to understand and study the science coordinator role (Madrazo & Hounshell, 1987; Perrine, 1984). However, large gaps in understanding the district science coordinator role exist, such as how coordinators can support teachers and student learning, and coordinators themselves are supported.

School Leadership

To better understand science coordinators and their role as school leaders, we utilized a set of leadership practices that successful districts commonly employ (Leithwood et al., 2004; Marzano, Waters, & McNulty, 2005; Murphy & Hallinger, 1988). For example, school districts that are aligned with national and state standards are more likely to engage in continuous improvement efforts and tend to implement more successful PD activities (Desimone, Porter, Birman, Garet, & Yoon, 2002). Districts with coherent and content-focused PD can greatly support change in teaching practice, and district decisions related to vision, PD activities, and human resources can influence the coherence and content-focus of PD programs (Firestone et al., 2005). Effective district leadership involves district leaders collaborating and working together to support teacher instruction and student learning (Leithwood et al., 2004; Murphy & Hallinger, 1988). Based on reviews of research of leadership practices in educational contexts, Leithwood (2012) suggests specific core leadership practices for teachers and principals that support classroom instruction. Core leadership practices include: setting directions, developing people, redesigning the organization, and improving the instructional program. Each of these categories is characterized further by specific leadership practices (Table 1).

Table 1

Overview of Core Leadership Categories and Practices

Category	Practices
Setting Directions	• Building a shared vision • Fostering acceptance of group goals • Creating high expectation • Communicating the direction
Developing People	• Providing individualized support and consideration • Providing intellectual stimulation • Modeling appropriate values and practices
Redesigning the Organization	• Building collaborative cultures • Restructuring the organization to support collaboration • Building productive relationships with families and communities • Connecting to the wider community
Improving the Instructional Program	• Staffing the program • Providing instructional support • Monitoring school activity • Buffering staff from distractions • Aligning resources

Note. Adapted from "Core practices: The four essential components of the leader's repertoire," by K. Leithwood, 2012, in K. Leithwood & K. Seashore-Louis (Eds.), *Linking leadership to student learning* (pp. 57-67). Copyright 2012 John Wiley & Sons, Inc.

While research suggests characteristics and practices of successful leaders, studies do not prescribe a "recipe" or one set of tasks a leader should follow to be effective (Marzano et al., 2005; Murphy & Hallinger, 1988). Instead, these practices should be implemented appropriately depending on district contexts and situations. Regardless, effective leadership practices, if implemented successfully, clearly relate to student achievement (Leithwood et al., 2004) and highlight the key role that administrators play in supporting teacher development. These leadership practices were used to frame this research study.

Purpose

The purpose of this study is to investigate the role of the district science coordinator and their perceived opportunities for PD. The research questions addressed in this study are:

1. What are the professional responsibilities of district science coordinators?
2. How do district science coordinators perceive and characterize opportunities to develop professionally?
3. How are the role, responsibilities, context, and backgrounds of science coordinators related?

4. What barriers do district science coordinators encounter in their role?

This study seeks to better understand the role of a district science coordinator across the United States. This study builds on Leithwood's (2012) work by extending the framework to science coordinators. This study leverages the core leadership practices to characterize various professional responsibilities and activities coordinators engage in to develop professionally. Understanding this role more clearly may illuminate areas in which district science coordinators need PD or pursue professional growth independently. Gaining this knowledge is critical to learning how we can support the improvement of science education within districts.

Methods

A convergent parallel mixed-methods design (Creswell, 2014) was adopted to explore the role of science coordinators. Within this design, quantitative and qualitative data were collected simultaneously, analyzed separately, and then results are compared to confirm or disconfirm the findings. The findings embed both the quantitative and qualitative data. This design allowed for comparison of different perspectives by drawing on both the qualitative and quantitative data.

Participants

Science coordinators who were members of the National Science Education Leadership Association (NSELA) were solicited to complete surveys. NSELA is a national organization committed to "communicate the principles and practices of effective science education leadership, build a community of science education leaders, and influence science education policies and practices" (Triangle Coalition, 2013). Members of NSELA include over 600 science department chairpersons, science coordinators, science supervisors, science education faculty, and science lead teachers from across the country. Of these, 206 members self-identify as science coordinators, as defined for the present investigation. The NSELA membership was selected as a representative nationwide sample of science coordinators because this organization includes a known membership and contact information was readily available.

Participants in this study included 84 females and 38 males from 29 different states. The majority of participants were from Virginia (14.8%), Ohio (10.7%), and Massachusetts (9.0%). Of these, 3 (2.5%) reported their ethnicity as African American, 99 (81.1%) identified themselves as Caucasian, 1 (0.8%) was Latina/o, and 2 (1.6%) self-identified as combined ethnicities. Seventeen respondents (13.9%) declined to provide their ethnicity. The majority of respondents (82%) reported being in their current position less than 10 years (Table 2). Of the respondents, 106 (86.9%) were former science teachers and 97 (79.5%) hold a degree in a science content-area. Respondents identified their titles in a variety of ways (Table 3).

Table 2

Years in Position

Years in Position	n (%)
0-3	45 (36.9%)
4-6	29 (23.8%)
7-9	26 (21.3%)
10-12	11 (9.0%)
13-20	7 (5.7%)
21+	4 (3.3%)

Table 3
Respondent Title

Title	n (%)
Science Supervisor/Coordinator	53 (43.4%)
Science Specialist	27 (22.1%)
Science Lead Teacher	10 (8.2%)
General Curr./Inst. Supervisor/Coordinator	9 (7.4%)
General Specialist	6 (4.9%)
Science Teacher	5 (4.1%)
Other	5 (4.1%)
Science Consultant	4 (3.3%)
Science Dept. Chair	3 (2.5%)

Data Collection

An initial email eliciting participation was sent to NSELA members that included a description of the study and a link to an informed consent agreement and the survey. This email also informed coordinators of the opportunity to win a gift card if they completed the survey. NSELA members were asked to complete the survey within a two-week window. Seventy-six participants completed the survey within this first two-week period. After two weeks, a reminder email was sent to the NSELA membership. Forty-five additional participants completed the survey. A final reminder was sent 2 weeks later. Another one participant completed the survey. Given this low response rate to the final request, we assumed at this point that no more NSELA members would complete the survey. Thus, a total of 122 out of 206 NSELA members self-identified as science coordinators completed the survey, representing a total response rate of 59.2%. Science coordinators self-selection into membership in NSELA and their subsequent completion of the survey are limitations of this investigation. One meta-analysis of web surveys reported an average response rate of 39.6% across 68 studies (Cook, Heath, & Thompson, 2000). This issue was partly resolved by sending two follow-up reminders to solicit more responses, resulting in an overall response rate of 52.9%.

A purposeful stratified sample of 16 (13.1%) participants were selected for a follow-up interview based on analysis of survey responses. Selection was stratified across district size, urbanicity, degree, and described role. The interviews occurred during the academic year following the survey administration. Survey and interview instrument development are detailed below.

Data Sources

Data sources included a Science Coordinator Role Survey and a semi-structured interview with a subset of purposefully selected science coordinators.

Science Coordinator Role Survey. The science coordinator role survey included three sections that included a combination of Likert, forced-answer, and open-ended questions related to the following: responsibilities as a coordinator, professional growth, and demographics (Appendix S1). The responsibilities section included seven questions regarding the science coordinators' content area and professional responsibilities, informed by Leithwood's (2012) core leadership practices. The professional growth section included five questions designed to elicit the types of PD science coordinators engage in and benefit from. Finally, the demographic section included eight questions about the participant and information about the district in which he or she served.

Prior to administration, the survey was reviewed by a panel of six experts in science education, evaluation, and measurement in order to establish support for face and content validity (Haynes, Richard, & Kubany, 1995; Newman & McNeil, 1998). Two rounds of review were conducted and recommended changes were incorporated into the final version of the survey. The survey was then piloted with a selected group of science coordinators. Modifications to the survey were made based on pilot results and feedback.

Science Coordinator Interview. The 23 question, semi-structured interview protocol (Appendix S2) included questions designed to characterize the role and responsibilities enacted by a district science coordinator, how they interact with other stakeholders in their district and their peers within and across districts, the type and context of PD received, and barriers encountered in enacting their role. Each interview lasted between 20 and 40 minutes and were tape recorded and transcribed for analysis.

A panel of six experts in science education, evaluation, and measurement reviewed the interview protocol to establish support for face and content validity prior to use (Haynes et al, 1995; Newman & McNeil, 1998). Two rounds of review and revision resulted in the final version of the interview used in the study.

Data Analysis

Results from the surveys and interviews were analyzed using qualitative and quantitative methods. For the quantitative analysis, responses for questions on desire for PD, school size, background, experience, and content-area and professional responsibilities were coded as follows: Participants' desire for PD was coded as no (0) or yes (1), school size was coded using the urban-centric locale coding system (http://nces.ed.gov/ccd/ commonfiles/glossary.asp), with the largest schools receiving a code of 1 and the smallest schools receiving a code of 12, experience was reported as years, and whether participants received a degree in science was coded as no (0) or yes (1). The total number of content-area responsibilities was summed for each participant. For example, if a participant checked that they were responsible for Science, English, Special Education, and Technology, they received a score of 4. Similarly, the total number of professional responsibilities was summed for each participant. The types of professional responsibilities were then aligned with the four Core Leadership Practices categories (Appendix S3). For example, developing and working toward a strategic plan for science in the district, aligning curriculum with state or national standards, and evaluating teachers were grouped into the *Setting Directions* category of Core Leadership Practices. Thus, there were three possible types of professional responsibilities in the *Setting Directions* category. After aligning the responsibilities with the leadership categories, the number of responsibility types each participant indicated was converted to a percentage of the possible responsibilities for each leadership category. For example, if a participant checked two of the three responsibility types in the *Setting Directions* category, they would receive a 67% score for that category.

Means and standard deviations were calculated for all variables. A correlation matrix identified significant relationships between participants' desire for PD, school size, experience, and content-area and professional responsibilities. Multicolinearity was tested, and no variables were highly correlated (Lewis-Beck, 1980). Based on the correlation results, a post-hoc t-test determined whether significant differences between the types of responsibilities for participants with and without a degree in science existed. Levine's test was violated for three of the four categories, therefore equal variance could not be assumed. Thus, a more conservative t-statistic was used. These results helped identify the interview participants, as described above.

A constant-comparative approach (Glaser & Strauss, 1967; Lincoln & Guba, 1985) was used to inductively analyze the interview and open-ended survey questions. Responses were open-coded using inductively-generated codes guided by the research questions, Leithwood's (2012) Core Leadership Practices, the researchers' prior knowledge, and inferences from the data. First, the data were studied holistically in order to inductively generate codes. The data set was read and re-read and initial categories were generated by two coders. The first rater developed initial categories, then the second coder coded the data using those categories and created additional categories as necessary. Next, the first and second rater determined whether categories should be retained or collapsed into other categories. This preliminary coding and discussion resulted in the final set of codes applied to the entire data set for each question. Inter-rater reliability was established to be 89.0 % once final categories were developed and applied independently to open-ended questions by the two raters. All disagreements in coding were resolved through discussion.

Results

The purpose of this mixed-methods investigation was to explore science coordinators' role, responsibilities, and PD opportunities, which are discussed first. We then describe the relationship between participants' role, responsibilities, context, and backgrounds. Specifically, we ascertained the relationship between district size and participants' professional responsibilities, participants' teaching experience and desire for PD, and participants' responsibilities and their desire for PD. We conclude the results by addressing the barriers participants' perceived in their role as science coordinator.

Responsibilities of Science Coordinators

Surveyed participants reported working with various grade levels and content-areas and indicated having a wide variety of professional responsibilities. Most participants, (48.4%) worked with students in grades pre-K-12; however, some participants reported working with only K-5 students (13.1%), only middle school students in grades 6-8 (6.6%), or only high school students in grades 9-12 (8.2%). Others reported working with K-8 students (5.7%), and another group worked only with 6-12 students (17.2%). One participant reported working with adult students.

Half of the participants' (n=62, 50.8%) sole responsibility was science and 54 (44.3%) of the respondents reported being the only person in their district responsible for science supervision at the district level (Table 4). Of the 60 (49.2%) who had multiple responsibilities, 43.4% (n=26) reported having responsibilities for STEM, engineering, math, and/or technology. Interviewed participants in smaller districts indicated they took on a coordinator role in another subject area such as social studies (SC110 Interview). Conversely, individuals working in large districts tended to be responsible for fewer grades and more schools. For example, one interview participant indicated she was the only elementary (K-5) science coordinator for 45 elementary schools (SC103 Interview), whereas another interviewed participant in a small district worked with only 10 schools preK-12, but was responsible for science and math (SC22 Interview). These interview data suggest that district size may be related to the number and variation of content-area responsibilities for a science coordinator.

Table 4
Participants' Reported Content-area Responsibilities

Area of Responsibility	n (%)
Science	115 (94.3%)
Other (Administrative)	24 (19.7%)
Math	19 (15.6%)
Engineering	17 (13.9%)
Technology	14 (11.5%)
English/Language Arts	13 (10.7%)
Social Studies	13 (10.7%)
Heath/PE	13 (10.7%)
Family/Consumer Science	6 (4.9%)
STEM	3 (2.5%)
Gifted Education	3 (2.5%)
Art	3 (2.5%)
Other	3 (2.5%)
Special Education	2 (1.6%)
ELL	1 (0.8%)

Note. Coordinators could select multiple content responsibilities.

All participants reported having multiple responsibilities that comprised their role as science coordinator. These included curriculum alignment and development (93.4%), disseminating information to teachers (91.8%), teaching students (24.6%) and co-teaching (6.6%), working individually and in small groups with teachers (98.3%) and administrators (91.8%), and analyzing data to inform their work (90.2%) (Table 5). Other responsibilities included leading PD for teachers, creating strategic plans for science, assisting in employment decisions and teacher evaluation, and safety/chemical hygiene.

Science coordinator responsibilities organized by Core Leadership Categories revealed participants focused most on *Redesigning the Organization* (77.05%) and *Setting Directions* (61.48%) (Table 6). *Redesigning the Organization* included responsibilities such as collaborating with other school leaders in their district and working to communicate with the community and other science coordinators. The lowest percentage of science coordinators' perceived responsibilities (42.62%) fell into the *Developing People* category of the Core Leadership Practices. These responsibilities focused on working directly with teachers and students.

The qualitative data provided evidence to support the quantitative data. For example, the following quote from one interviewed participant described her multiple responsibilities and is representative of the comments made by other interviewed participants:

> I'm the person that has all the basic communications with, about science content and curriculum and testing updates and that type of thing with grades 6 through 12. I am the person that organizes all of the professional development that's specific for grades 6 through 12. And sometimes it's K-12 depending….So for example this summer we're offering several courses to teachers this summer. Some are from POGIL workshops to WestED workshops to homegrown workshops about classroom management type things, and I'm doing all that. Get everyone signed up and that type of thing. I'm the one that coordinates for microscopes, balances, what I'm working on now. I'm the person that deals with the safety stuff. I've been a lead person on that. I'm the one that makes

> decisions on curriculum as far as supplemental and other things that we would bring into the district. I have budgets. I have to make sure I am following grant deadlines, that I'm collecting the correct data. I have to do all the back-end paperwork for that. I'm the one, I go out into schools. I observe teachers. I make recommendations. So that type of thing. I'm sure I've got others but that's a lot. (SC55 Interview)

This participant's stated responsibilities aligned with the *Developing People* and *Improving the Instructional Program* components of the Core Leadership Principles.

Table 5
Participants' Professional Responsibilities

Professional Responsibilities	n (%)
Aligning curriculum with standards	114 (93.4%)
Disseminating information to teachers	112 (91.8%)
Working with administrators	112 (91.8%)
Analyzing data to inform future work	110 (90.2%)
Working with groups of teachers (including PD)	109 (89.3%)
Curriculum development	109 (89.3%)
Developing a strategic plan	107 (87.7%)
Working with teacher leaders	101 (82.8%)
Collaborating with other coordinators	100 (82.0%)
Working 1-on-1 with teachers	94 (77.0%)
Ordering supplies	94 (77.0%)
Developing community relationships	82 (67.2%)
Presenting at conferences	75 (61.5%)
Monitoring budget	73 (59.8%)
Administrative duties	72 (59.0%)
Assisting in employment decisions	51 (41.8%)
Teaching K-12 students	30 (24.6%)
Working with students outside of class	19 (15.6%)
Co-teaching daily	8 (6.6%)
Grant writing	8 (6.6%)
Safety	5 (4.1%)
Evaluating teachers	4 (3.3%)

Note. Coordinator responses could include multiple responses.

Table 6
Percentage of Participant Professional Responsibilities Organized by Core Leadership Practices

Category (number of possible prof. responsibilities)	All % (n=122)
Setting Directions (3)	61.48
Developing People (5)	42.62
Redesigning the Organization (5)	77.05
Improving the Instructional Program (9)	57.74

Interview data also revealed a more nuanced understanding of how participants interacted and worked with groups of teachers (89.3%), one of the most cited responsibilities on the survey. Several participants indicated that working with teachers to prepare for testing and analyzing test data had become a major focus of their work over the last few years. For example, one respondent described a PD opportunity she was getting ready to provide and the reasons for it:

> I go out and I do the presentation that they [superintendents] think the staff needs to know and then I give like, right now I'm working on a presentation coming up here with a district that is really not prepared for the new testing format. They have not moved their instructional practices and they think they are just fine, and when I took the superintendents through all of our tests as well as our state next-generation science assessments, they were so blown away and said, "Oh, my gosh, we are not prepared. We have not changed our paradigm. Our teachers are not teaching what they need to teach." So, I'll come out and do that presentation based upon what they defined as a need that they saw at the meeting. (SC33 Interview)

Many participants stated they would like to have more interactions with the teachers in their district but were unable to do so due to lack of resources and time. For example, when asked about how he interacted with teachers one coordinator stated, "Again, not as much as I'd like or as we'd like" (SC117 Interview). He went on to describe that he met only twice a year with all teachers, but worked with a focus group of teachers on a monthly basis. Other interviewed participants indicated their primary interactions with teachers occurred through email, monthly meetings, and occasional PD opportunities (i.e. SC3 Interview, SC23 Interview, SC111 Interview). Taken together, these data suggest that participants' interactions with teachers in their district were infrequent and focused on standardized testing and that some participants were aware of the disconnect between what they wanted to do and what they were able to do.

In summary, both survey and interview data illustrate the varied content-areas and responsibilities that participants take on in their role as district science coordinator. These responsibilities appear to be influenced by external factors such as school size, standardized testing, and available resources. Further, coordinators' responsibilities centered around *Redesigning the Organization* and *Setting Directions*.

Professional Development Opportunities for Science Coordinators

In addition to describing their professional responsibilities, participants also described PD they had experienced. Specifically, they reported on the types and focus of PD in which they enjoyed participating in and the PD experiences that facilitated collaboration with science coordinators in other districts. Respondents reported they enjoyed participating in PD experiences in formats that included conferences, short activities, and collaborative study groups, among others (Table 7). In interviews, participants also indicated the presence of consortia in their states that provided opportunities for them to interact with others in similar positions (SC3 Interview, SC111 Interview). For example, one participant stated "Every 6 months, we have a meeting with our state Association Science Supervisors, and it's usually basically about a 2.5 or 3-day meeting. There are sessions that we have where we talk about things" (SC3 Interview).

Of respondents, 107 (87.7%) indicated they have had opportunities to interact with other science coordinators during PD. PD experiences that allowed for interactions between science coordinators from different districts within a given state were most prevalent. For example, participants reported interacting with other science coordinators most often during state/regional science leader meetings (46.7%) or state science teacher meetings (24.6%). National science leader meetings (18.0%), national science teacher meetings (20.5%), general PD experiences (23.0%) also provided opportunities for science coordinators to interact with each other. Science coordinator PD (8.2%), working with state department of education (11.0%), and reaching out to other science coordinators (12.0%) appeared to provide less opportunity for science coordinator interaction. Interview analysis confirmed the majority of participants interacted with other coordinators during state or national meetings (SC33 Interview, SC71 Interview, SC110 Interview); however, it seems these settings may not allow for the depth of connection or interaction participants desire. For example, when asked about opportunities for interactions with other coordinators, SC71 responded, "Not very often. That's the unfortunate thing." Despite attending national and state meetings SC71 still had difficulty connecting with other coordinators and learning how she could find support for her own work from others in her position.

Table 7
Format of Professional Development Enjoyed by Science Coordinators

Professional Development Format	n (%)
Conferences	99 (81.1%)
One-to four-day activities	62 (50.8%)
Collaborative/study groups	32 (26.2%)
Online courses over several weeks	17 (13.9%)
Weeklong/multiple week courses/Institutes	11 (9.0%)
College/University courses	11 (9.0%)
School district-sponsored courses	3 (2.5%)
Self-directed research	1 (0.8%)
Other	1 (0.8%)

Note. Participants' responses may have included multiple formats.

Analysis of open-ended survey responses revealed participants most frequently engaged in PD that emphasized: understanding student learning, learning to incorporate inquiry, learning to implement the *Next Generation Science Standards* (NGSS) or state Standards, learning to use technology, and learning teaching and assessment strategies (Table 8). Interview analysis also indicated participants perceived PD opportunities to learn about integrating literacy and to further understand the ongoing changes in state policies as important. One participant described his reasoning for attending PD opportunities to learn about literacy for his district:

> And then as our state moves toward increasing effectiveness, we've been more involved with common core standards and things, we've been more involved with things like literacy support in the content areas and writing learning objectives and things like that for teachers to help support them in their professional growth and in students' growth in literacy components. (SC63 Interview)

Similar to other respondents, this participant recognized the need to understand how to support teachers in teaching literacy as a result of the changing policies within his state and across the nation.

Similarly, 62% of participants indicated they had adequate PD opportunities, but 112 (91.8%) stated they would also like more PD opportunities to interact with other science coordinators. Their rationales for wanting more PD experiences with other science coordinators included the following: collaboration and sharing ideas, decreasing isolation, science coordinator-specific PD, sharing resources, and learning how to design PD to support NGSS, state standards, and STEM (Table 9).

Table 8

Topics of Professional Development for Science Coordinators

Professional Development Topics	n (%)
Understanding student learning	43 (35.2%)
Learning to incorporate inquiry	40 (32.8%)
Learning about/how to implement the NGSS/state standards	36 (29.5%)
Learning to use technology	27 (22.1%)
Learning teaching strategies	25 (20.5%)
Learning to assess students	21 (17.2%)
Deepening content knowledge	12 (9.8%)
Learning to work with diverse learners/students with special needs	8 (6.6%)
Learning leadership skills	5 (4.1%)
No professional development	4 (3.3%)
Learning to integrate literacy/writing	4 (3.3%)
Learning about teacher evaluation	3 (2.5%)
Learning about PLCs	2 (1.6%)
Learning about textbook adoption	1 (0.8%)

Note. Participants' responses may have included multiple topics of PD

Table 9

Participants' Rationales for Professional Development with other Science Coordinators

Rationale	n (%)
Collaborate, network, and share ideas with peers	82 (67.2%)
Learn professional development strategies	29 (23.8%)
Science coordinator-specific focus	22 (18.0%)
Learn about curriculum/assessment	19 (15.6%)
Share resources (e.g. funding, materials)	10 (8.2%)
Decrease isolation	8 (6.6%)
Need more time to collaborate with peers	7 (5.7%)
Other reasons	4 (3.3%)

Note. Participants' responses may have included multiple rationales.

For example, a representative response for the rationale for PD regarding sharing ideas and collaboration from one respondent was, "It is always important to collaborate with peers to learn and grow together in leadership and PD strategies" (SC2 Survey). Another participant discussed learning about what works in other districts, noting, "It is beneficial to collaborate with others with similar positions and professional responsibilities. I like hearing others' curriculum ideas or methods for overcoming shrinking budgets and other challenges public schools face" (SC86 Survey). Finally, 30 (24.6%) of respondents discussed the isolated nature of their work environment and how science coordinator PD may help them overcome the feeling of isolation as a rationale for PD. One participant described this, "Very few people (including my boss and other content specialists) understand our role, workload, and responsibilities. It's nice to have a support system as well as someone to collaborate with" (SC32 Survey).

In summary, participants indicated they engaged in PD that was typically short in duration and provided by state-wide leadership communities. These PD opportunities for participants varied in the topics covered, but many participants agreed interacting with other science coordinators was one of the most important reasons for engaging in PD.

Role, Responsibilities, Professional Development, Context, and Background

The survey data revealed significant, moderate correlations (Cohen, 1992) between the size and type of the school district, whether participants held a degree in science, and the number of responsibilities they reported (Table 10). Specifically, a significant negative correlation existed between participant's degree in science and district locale. A significant positive correlation was noted between participants' district locale and number of content area responsibilities. These correlations indicated participants without science degrees tended to have positions at smaller, more remote rural school districts and are likely to be responsible for multiple content areas including science. A significant positive correlation between total number of professional responsibilities and degree in science and a negative correlation between degree in science and number of content area responsibilities confirmed participants with no science degree tended to be responsible for multiple content areas. Participants in larger, urban school districts tended to have science backgrounds, more professional responsibilities, and were more focused on the science content-area than participants from smaller, rural school districts. No significant correlations existed between participants' years of experience or the desire for more PD and any other variables.

Table 10

Means, Standard Deviation, and Correlations Between Variables

	M	*SD*	1.	2.	3.	4.	5.	6.
1. District Locale[1]	5.00	3.01	1.00					
2. Degree in Science[2]	.795	.41	-.277**	1.00				
3. Years in Position	6.38	5.91	-.071	-.023	1.00			
4. # Content-Area Responsibilities	2.10	1.62	.232*	-.214*	-.049	1.00		
5. Total # of Prof. Responsibilities	13.02	3.33	-.137	.236**	.076	-.142	1.00	
6. Desire for Prof. Development[2]	.62	.49	.136	-.06	-.116	.047	.077	1.00

Notes: * Indicates statistically significant at $p<0.05$

[1] District locale coded 1 (largest) to 12 (smallest) according to the NCES urban-centric locale assignment system (http://nces.ed.gov/ccd/commonfiles/glossary.asp).

[2] Degree in science and Desire for PD coded as no (0) and yes (1).

A significant positive correlation existed for some variables when the types of professional responsibilities were classified under the four Core Leadership Practices categories (i.e. Setting Directions, Developing People, Redesigning the Organization, and Improving the Instructional Program) and compared with other variables. Specifically, a significant positive correlation existed between *Setting Directions* and degree in science (r=.228), and between *Improving Instructional Programs* and degree in science (r=.197). Post-hoc t-tests revealed participants with science degrees reported significantly more responsibilities aligned with *Setting Directions* and *Improving the Instructional Program*. These two categories focus on teacher evaluation, alignment with *Standards*, and curriculum development.

Barriers

In interviews, participants identified several barriers that they perceived limited their effectiveness in their role. These barriers included a lack of time, lack of emphasis on science instruction, and a lack of power to enforce policies within a district. Time was especially an issue for those serving in smaller districts and/or those who were responsible for multiple content areas. For instance, when asked about barriers in her role, SC22 said, "Time. Mainly time, just because I am K-12 math and science, it's just time, to be able to give all my attention to being split between the two. It's just time" (Interview). The needs for time, whether to do more work, or for more PD time with teachers was echoed by a majority of the participants.

Participants frequently mentioned the focus on reading and mathematics as a barrier to being successful in their work. For example one respondent stated:

> One of the frustrating things for a lot of science leaders, not just in [state x] but nationally, is that the increased focus on high stakes testing has really, I think caused a shift in emphasis away from science education to math and literacy. Even with more of a national push towards STEM education, I think that its, especially at the elementary level there are a lot of places where science instruction has fallen by the wayside to make room for more literacy and mathematics. And that's an unfortunate trend. (SC110 Interview)

Another participant voiced her concerns and frustration about the amount of science elementary students in her district receive:

> I think the fact that science is not a priority and neglected is infuriating. We work in a large urban district with largely high needs students, and they just flat out get denied science education. And I think that's a violation of their rights, and so that's really a challenge to me. (SC117 Interview)

As evidenced by the representative quotes above, science was often neglected at the elementary level and getting buy-in from teachers and/or other district administrators was perceived as a challenge for participants.

In addition, the lack of power participants' have to enforce policies was another barrier to being effective. One participant stated:

> It is a "consulting position", so, you have, you want to do a lot of things, you know, and you have lots of ideas, but you have to always get the buy-in to get districts to come along with you or to get a superintendent to say, "Yeah, let's try this" or "No, this isn't for us". So, it's very frustrating that you only stand to serve and to offer and no one has to take your offerings, you know. (SC33 Interview)

This participant perceived the superintendent as the gate-keeper that had to approve any new ideas before they were implemented in the school district. Another participant stated:

> I don't really have the authority in my role in our district to mandate anything, so I really have to encourage and facilitate collaboration and coordination, and I really can't tell anyone they have to do anything. I guess that is somewhat a barrier in itself because you do reach a point with some teachers where unless somebody tells this person they have to do this, this classroom is always going to be out in left field on its own. That's not fair to the kids in the class. (SC23 Interview)

This lack of power to enforce polices or to ask teachers to use best practices in their classrooms may trickle down, ultimately impacting the experience and learning of students. It was clear that this participant, and other interviewed participants' ultimate concern was for the impact of their work with teachers and students.

In summary, interview data revealed barriers participants perceived as impacting their role as a science coordinator. These barriers included a lack of time, lack of emphasis on science instruction, and a lack of power to enforce policies within a district. Interview participants concerns about their effectiveness as a science coordinator was focused on how they were able support teachers, but more importantly how these barriers impacted the students in their district.

Discussion & Implications

This study is the first of its kind to characterize a national sample of science coordinators in the age of standardized testing to better understand who they are and what they do to help support science teachers in their districts.

Who Are Science Coordinators?

Our data suggest that science coordinators are typically a Caucasian female who holds a degree in a science content-area and is a former science teacher who has been in the coordinator role for less than ten years. Most respondents hold the title of Science Supervisor, Science Coordinator, or Science Specialist, but currently, no defining title or national standards for individuals in the science coordinator position exist. In some states, a science supervisor may be the individual responsible for science at the state level, while in other states the same title may used be a district level supervisor. Whether or not this ambiguity contributes to different perceptions and expectations of individuals in this position has not been studied, but may be an important factor for researchers to consider (Madrazo & Hounshell, 1987). These results substantiate and update previous research indicating a diversity of titles for this position across the United States (McComas, 1993) and add to the literature by providing demographic characteristics of who science coordinators are currently.

What do Science Coordinators do?

The results of the present study begin to fill the existing void in the research presently available on science education leadership by presenting a picture of the professional responsibilities of science coordinators (Luft & Hewson, 2014; PCAST, 2010). The majority of science coordinators who responded to the survey were responsible for working with students in grades PK-12. Although having responsibility for all grade levels may allow coordinators to be solely responsible for science, as indicated by 50.8% of participants, it may stretch the abilities of coordinators beyond their expertise. Taken together, the results of the present investigation and the Whitworth (2014) study suggest districts may need to consider how to structure their administration and/or provide PD for leaders working with teachers outside of their content area or grade level expertise.

Results indicated science coordinators have multiple professional responsibilities and that there was no relationship between years in position and total number of responsibilities. Thus, when science coordinators enter their role as a coordinator they may be expected to immediately take on all of these professional responsibilities. These results highlight the difficulty in understanding the role of the district science coordinator; they are often wearing multiple hats and carrying out multiple responsibilities.

It is unclear from the data collected in the present investigation whether these individuals are prepared for these professional responsibilities or would benefit from PD during their first few years in the position. The research on the induction of K-12 teachers (Luft, 2001) suggests K-12 teachers experience barriers to their success and benefit from opportunities to grow and develop. The results of the present investigation suggest this trend may also exist for science coordinators; however, further investigation is needed to assess whether coordinators also benefit from opportunities to grow and develop.

Participants' professional responsibilities were also analyzed through the lens of Leithwood's (2012) categories of Core Leadership Practices, adding to the literature on leadership practices. Results indicated science coordinators with science degrees took on science-specific coordinator roles with leadership practices focused on the science curriculum, while participants without science degrees roles and responsibilities varied more. This suggests that science coordinators' expertise in science may play a role in the types of leadership responsibilities they take on within their district. Superintendents and other high-level district administrators may need to account for these differences as they consider job descriptions and hiring qualifications for these positons.

Professional Growth Opportunities

The majority of science coordinators indicated the amount of PD opportunities available to them were sufficient; however, almost all participants desired more PD. We found no correlation between years in position and the desire for PD. Thus, science coordinators may recognize their need for continual growth and PD and seek out these opportunities throughout their careers. Further, the desire for more PD was not significantly correlated with participants' responsibilities, district locale, or degree in science. Regardless of participants' district locale, background, or varied responsibilities, all appeared to want more PD opportunities.

Previous research suggests PD of short duration is ineffective in changing science teacher's reform-based practices and understandings (Desimone, 2009; Desimone et al., 2002), and yet science coordinators most enjoyed conference and one-to four-day activity PD formats. Given the difference in teacher and science coordinator roles, it is possible that effective PD for science coordinators looks much different than it does for teachers. It may be that coordinators prefer these types of opportunities as they have many demands on their time, as evidenced by their multiple state responsibilities, and PD of short duration are easiest to fit into their schedules. Thus, further research understanding science coordinator PD and how it impacts this group of leaders is a largely unexplored area of research in need of further development. Alternatively, science coordinators may not be aware of what they need to develop professionally, and creating opportunities for science coordinators that are of sufficient duration and enticing to coordinators is an important consideration for professional developers.

Results also indicated there were a variety of foci of the PD attended by science coordinators and the majority of science coordinators indicated they have opportunities to interact with colleagues. However, results indicated only a small percentage of these opportunities (8.2%) were specifically designed and intended for science coordinators. Rather, the majority of opportunities for interacting with other science coordinators occurred during regional or state leader and teacher meetings and almost all coordinators indicated they would like more PD opportunities to interact specifically with science coordinators. Taken together, these results indicate that despite ample opportunities for science coordinators to attend PD and interact with other science coordinators, there is a strong desire for more science coordinator-specific opportunities.

Most science coordinators also indicated that PD should provide opportunities to collaborate, network, and share ideas with peers. It is likely that current PD opportunities for science coordinators do not provide this type of engagement. Many coordinators indicated interactions with peers allowed them to learn from each other and develop as leaders without reinventing the wheel. Peer interaction may facilitate more efficient and effective science coordinator development into the science leaders districts require to be successful. An example of such a science coordinator-specific PD opportunity is the Virginia Initiative for Science

Teaching and Achievement (VISTA) New Science Coordinator Academy (NSCA). Through a year-long experience with 2 days of meetings in the fall and 3 days of meetings in the spring, the VISTA NSCA intentionally provides science coordinators the opportunity to collaborate and interact with peers in meaningful ways (for details and specifics of the program, see Edmondson et al., 2012). Results of an evaluation of the NSCA suggested it was effective in facilitating coordinators' understanding of how to design and implement a strategic plan and how to develop effective PD for teachers around science inquiry. Results indicated the NSCA also helped science coordinators build and maintain sustained relationships with peers across the state (Whitworth, 2014). The results of the present investigation suggest an approach such as the VISTA NSCA, with short initial duration but prolonged support, may meet the needs of science coordinators while also being effective PD for this group of leaders. Further, the format of the NSCA may entice science coordinators to participate because the time burden is spread throughout the year instead of concentrated.

Results of the present study suggested relationships between school district type and size and content-area responsibilities and whether or not a science coordinator had a science degree existed. The individuals responsible for science in small districts are typically generalists who may actually be responsible for all curriculum and instruction within their district, while science coordinators with a degree in science are more likely to be employed in urban districts and have more professional responsibilities. Similar to Whitworth (2014), the results of the present investigation suggest coordinators in smaller districts may need more content-specific PD to provide the best support for science teachers and students, while science coordinators in large districts might need more administrative-specific PD.

Further, regardless of the responsibilities, science coordinators appear to be stretched thin. Research on K-12 teachers suggest teacher practices develops over a prolonged period of time (e.g. Luft, 2001). While science coordinator 'effectiveness' was not measured in this study, it may be important to understand how science coordinators develop over time and how, if at all, their 'effectiveness' changes over time spent in the position. Should more seasoned science coordinators be more effective, high-level district administrators should find ways to retain science coordinators in their positions.

Barriers

Comparable to other areas of science teacher education research (Anderson, 2002; Jorgenson, MacDougall, & Llewellyn, 2003; Keys & Bryan, 2001), the participants in this study experienced barriers as a result of reduced emphasis on science education in the classroom. In fact, 27% of elementary schools across the United States reported having insufficient time to teach science (Banilower et al., 2013). The effects of state-mandated testing at the elementary level appears to have an effect on the amount of time teachers devote to science instruction (Anderson, 2002; Keys & Bryan, 2001), and this clearly shaped science coordinators perceptions of their ability to support teachers in their science instruction in the present study. Given this, science coordinators may need more PD around how to think creatively about addressing science standards through the integration of science with other subject areas.

Science coordinators also indicated lack of time was a barrier their effectiveness. A lack of time may indicate the position carries more responsibility than is realistic for a single person. This suggests the need for more resources (e.g. funding, PD) to be devoted to the responsibilities of this position. Finally, participants noted another barrier was a lack of power; they had very little influence over whether or not principals and/or teachers implemented their suggestions in the classroom. These findings further our understanding of the science coordinator role, but also suggest science coordinators' effectiveness within a district may be hindered by contextual factors. Decisions made by these district leaders may have less impact on improving teaching and learning than previously thought. We suggest researchers examine the dynamics between administration, specifically superintendents and science coordinators, to better understand the change process within a school district. It may be that PD for science coordinators may not be sufficient to overcome systematic barriers to improving teaching and learning.

Future Research

This survey-designed investigation was based on the self-report data of participants. Thus, one limitation that must be taken into consideration when interpreting the results is the self-selection of the sample; not all individuals sent the survey responded. Because the data were self-reported by participants, the findings of this study are accurate to the extent that the self-reported information is accurate. The results of self-reported data in educational research have mixed outcomes regarding the accuracy of self-report data (e.g., Jeff & Julie, 1991; Maxey & Ormsby, 1971; Smith & McCann, 1998; Traub & Weiss, 1982). However, this investigation also incorporated interviews with a subset of participants in order to triangulate the data and increase the reliability of the findings. This survey-designed approach provides first steps to broadly investigate the roles and responsibilities of science coordinators. Future research should also explore the roles and responsibilities of science coordinators through methodologies such as ethnography.

Final Thoughts

The findings of the present study provide insight into the role of a science coordinator and further defined the responsibilities coordinators hold. Science coordinators' demographic characteristics, professional responsibilities, and opportunities for professional growth were elucidated. Given the ambiguity of position titles and corresponding responsibilities, it may be helpful to develop accepted definitions and corresponding responsibilities for those serving in the science coordinator position. Doing so has the potential to make expectations explicit for all stakeholders involved in work with science coordinators.

The PD opportunities coordinators reported participating in, preferring, and desire for the future while serving in this role were also characterized. Our findings suggest science coordinators desired more PD opportunities to interact with other science coordinators and that few of these opportunities presently exist. In addition, coordinators serving in smaller districts, across larger grade spans, or without a science degree may need more content-specific PD to assist them in their support of teachers and students. Continuing to design PD opportunities for science coordinators, who have an influential role in the improvement of schools and teacher growth, is critical to improving student learning and achievement in science.

Many parallels exist between what we know to be effective K-12 science teacher PD and the PD opportunities science coordinators in the present investigation desired (e.g. opportunities for collaboration). However, given the different responsibilities of K-12 teachers and those of science coordinators, and the areas in which science coordinators in the present investigation reported the need for more support (e.g. developing budgets, finding and disseminating curriculum, etc.) and the many time pressures they reported, it is possible that effective science coordinator PD should look markedly different from PD for K-12 teachers.

Over the past 25 years, little research has been conducted on science coordinators' role, responsibilities, and PD. Thus, this investigation serves as a foundation to begin to understand the role of science coordinators in supporting the teaching and learning of science. It provides vital information about those persons responsible for the day-to-day professional growth and support of science teachers.

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