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Introduction

The shift in teacher practice to align with Next Generation Science Standards (NGSS) necessitates significant support for educators, including quality instructional materials, ongoing PD, and content-specific coaching. Science teacher leaders (STLs) can be a resource for providing sustained support on-site; especially at the elementary level where administrators tend to have a background in reading or mathematics and are not well-equipped to lead these reforms, and elementary teachers may avoid teaching science and have negative attitudes toward it. Developing STLs at the elementary level is an important strategy for building the capacity of elementary teachers and supporting a transition to NGSS across a district. STLs are able to lead their colleagues by recognizing and correcting gaps in content knowledge, sharing resources, collaborating with others, modeling equitable science instructional practices and advocating in service of effective science instruction (Cheung et al., 2018). There is a limited understanding of how elementary STLs interact with their colleagues and administrators to support a district-wide transition to NGSS. This paper adds to the literature by examining the leadership activities and interactions of three STLs as they supported their colleagues in this transition. This research follows a systems approach, exploring individual and multi-system factors that afforded or constrained STLs in their development from managerial roles to coordinating improvement efforts to learning about one's own practice and adopting and sharing strategies that accelerate student learning.

Research Questions:

- (1) What types of ongoing support do science teacher leaders provide to their colleagues?
- (2) In what ways do teacher leaders interact with their colleagues/admin?

Methodology

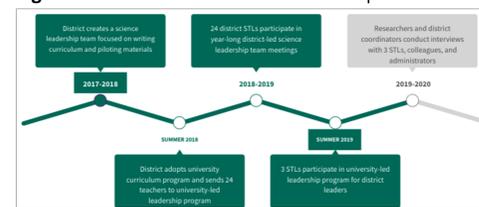
Research Design:

This qualitative case study (Yin, 2008) examines the personal attributes of STLs, their administrators, their colleagues, and the environmental processes and interplay between these processes that influence science teacher activities over time. Following the bio-ecological framework (Lewthwaite, 2011) researchers collected qualitative data at multiple systems levels representing three cases of teacher leadership. Members of the district science leadership team (n=3) and a colleague and administrator for each STL (n=6) participated in semi-structured interviews about the role and activities of the STLs (Table 1). Artifacts from the program including agendas, notes, and action plans were also collected to provide detail and context for interview responses.

Context:

This study takes place within a large, suburban school district in the Midwest that was involved in a university-school partnership to support a transition to the NGSS. Considering challenges to sustainability of teacher leadership, the district and university collaborated such that the district concurrently developed a district leadership team to include supportive structures, such as PD opportunities and ongoing collaboration time. Teachers participated in district and university-led meetings and professional development sessions over the course of 3 years (see Figure 1).

Figure 1. Timeline of teacher leader development



Analysis

The research team recorded and transcribed interviews. Qualitative coding software was used to organize data and analyze themes. The three researchers independently developed codes using an inductive, emergent approach. The team then met to check codes for accuracy and consistency and developed themes based on commonalities among codes. Each of the most frequently occurring themes was organized by research question (see Tables 2 and 3).

Figure 2. Factors contributing to STL activities across four domains: modeling, advocating, collaborating, and providing resources

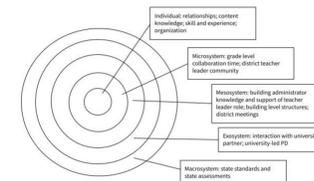


Table 1. Summary of participants

Elementary Building	STL	Colleague	Administrator
School 1 835 students	T1 Grade 6; 3 years teaching	C1 Grade 5	A1 Principal
School 2 782 students	T2 Grade 4; 22 years teaching	C2 Grade 4	A2 Principal
School 3 924 students	T3 Grade 2; 7 years teaching	C3 Grade 4	A3 Assistant Principal

Figure 3 STL at PD and sharing knowledge via Twitter



Findings: Research Question 1

STLs supported their colleagues primarily by coordinating the district-wide transition to NGSS. STLs did this by providing resources, managing the logistics of hands-on kit deliveries and serving as a communication hub between teachers and the university providing the kits and instructional materials. STLs provided some additional instructional supports to teachers at their grade level - they shared ideas, tips and tricks, and pacing suggestions. This support was limited to providing resources and collaboration and did not move into modeling, observation, discussion of teaching practices or other activities that directly impact student learning.

Table 2. Assertion 1: STLs Coordinate the improvement effort

	Frequency	Representative Quotes
Resources: Kits, materials, and online	14	“She showed us the Google Drive.” - C2 “Asking them if they had gotten their kits, and if they were missing any materials.” - T2 “We get information from them like in regards to like when kits are due.” - C3
Communication hub	8	“the communication between like [the university] itself and our building, being that person to communicate.” - T3 “they’re definitely a go between.” - A3 “Her communication. The communication that [the university has] has especially in the beginning with wanting to tweak things to make it user friendly for us and what we needed was huge.” - A1
Grade level support	7	“On my own grade level, I know that I’ve tried to stay ahead of the game a little bit and making sure that I know what’s coming next.” - T2 “Teachers from other schools like a lot of other Sixth grade teachers... we’ll talk to each other about our lessons.” - T1 “For my team specifically like grade level I did the pacing guides.” - T3

Findings: Research Question 2

STLs interacted with colleagues primarily through formal, scheduled meetings, including district leadership team meetings, building faculty meetings, and grade level team meetings. STLs took an open-door policy to leadership, sharing that they were available if their colleagues needed them. Based on the analysis little interaction occurred between colleagues and administrators and the STL despite the offer, and this was attributed to their colleagues not seeking out support and a lack of knowledge of the role of the STL.

Table 3. Assertion 2: STLs interact primarily through formal district meetings, or not at all

	Frequency	Representative Quotes
STL available for support	16	“She’s been communicating with staff, just asking them hey what are, if you have any questions, concerns, anything I can help with.” - A1 “her emails are just if they have ideas that they’re wanting to try or if they have questions like she’s willing to help support.” - A2 “I like to leave my door open and just let them know that they can look in.” - T1
Teachers don’t seek out support	8	“I don’t know that I’ve really needed anything this year.” - C1 “The only people that really come to me that need help with specific lessons and like content is just my team” - T3 “They don’t have as many questions and they don’t have as much that they support-wise that they need for me.” - T2
Lack of knowledge of role	7	“I don’t know if any, if they really know that they can come to me with that type of questions.” - T3
Meetings and events	5	“The one thing I know she does also is have a monthly leadership team meeting...any updates that are needed she’ll provide the staff, you know the leadership team with updates at that monthly meeting” - A2

Discussion and Implications

STLs were successful in supporting a transition to NGSS. This support primarily took the form of providing resources, although teachers did collaborate some with their grade level team. As their colleagues became more familiar with the NGSS and the new instructional materials, STL support and interactions decreased, rather than transitioning to a focus on supporting continuous improvement and accelerating student learning. This challenge is in line with previous studies of science teacher leadership (e.g., Fairman & Mackenzie, 2015). Factors contributing to STL success include individual attributes and the systems that formed the context for their work. Using the bio-ecological framework (Lewthwaite, 2011) we identified factors at each level that served to afford or constrain leadership activities over time (see Figure 2). Teacher PD must be clearly constructed in ways that not only support individual teacher growth, but also allow teachers to analyze system level factors within their context and coordinate with district and building administrators to create action plans for enabling site specific supports. Technology, such as Twitter, can be an important tool for enabling STLs to interact with colleagues.

Conclusion

Although the district and university partner worked closely together to meaningfully support STLs, there were still limitations to STLs ability to lead and impact teacher practice and student learning on site. STLs as a group were able to define their roles, reflect on and share their work with each other, and organize a support network through district-led monthly meetings. However, STLs main role was still limited to primarily sharing resources. This was due to personal attributes and environmental factors on site, such as the hands-off nature of building administrators, the lack of clear prioritization and definition of teacher leadership, and the lack of infrastructure at the building level to cultivate agency and impact. This study adds to the literature by providing insight into the affordances and constraints at the individual and multi-system environmental level for supporting science teacher leadership and provides important considerations for practitioners designing professional development for elementary STLs.

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