Moving beyond providing resources: A multi-system analysis of science teacher leadership

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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 (Gee 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/administrators?

Methodology
Research Design:
This qualitative case study (Yin, 2008) examines the personal attributes of STLs, their roles in supporting their colleagues, their collaborative and the environmental processes and interactions between these processes that influence science teacher activities over time. Following the bi-ecological framework (Leitwthaite, 2011) researchers collected qualitative data at multiple systems levels representing three different domains. 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).

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).

Table 1. Summary of participants
<table>
<thead>
<tr>
<th>School</th>
<th>Building</th>
<th>STL</th>
<th>Administrator</th>
<th>Colleague</th>
<th>Grade level</th>
<th>Grade level support</th>
</tr>
</thead>
<tbody>
<tr>
<td>School 1</td>
<td>BIS</td>
<td>Grade 7, 2 years teaching</td>
<td>Grade 4</td>
<td>Assistant Principal</td>
<td>782 students</td>
<td>3 years</td>
</tr>
<tr>
<td>School 2</td>
<td>Grade 6, 12 years teaching</td>
<td>Grade 4</td>
<td>Grade 7</td>
<td>Assistant Principal</td>
<td>782 students</td>
<td>3 years</td>
</tr>
<tr>
<td>School 3</td>
<td>Grade 7, 2 years teaching</td>
<td>Grade 3</td>
<td>Grade 4</td>
<td>Assistant Principal</td>
<td>782 students</td>
<td>3 years</td>
</tr>
</tbody>
</table>

Table 2. Assertion 1: STLs coordinate the improvement effort
<table>
<thead>
<tr>
<th>Resources: Kits, materials, and online</th>
<th>Frequency</th>
<th>Representative Quotes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication hub</td>
<td>7</td>
<td>&quot;She showed us the Google Drive.&quot;</td>
</tr>
<tr>
<td>Grade level support</td>
<td>7</td>
<td>&quot;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.&quot;</td>
</tr>
</tbody>
</table>

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 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 constraints that are out of their control for their work. Using the bi-ecological framework (Leitwthaite, 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 others and organize a support network through district led monthly meetings. However, STLs main role was still limited to primarily 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 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 constraints that are out of their control for their work. Using the bi-ecological framework (Leitwthaite, 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.

References