

# A Role Identification Activity to Support Science Teacher Leaders in Identifying Professional Learning Needs

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## Abstract

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Science teacher leadership has been identified as an important factor in the improvement of science education. However, there is wide variation in how leadership roles are assigned or taken up by science teachers. This makes designing professional development for science teacher leaders challenging. In this article, we present an activity designed to support science teacher leaders in identifying the leadership roles they occupy and the roles they would like to develop further through professional development. We present data from a group of science teacher leaders who participated in a professional learning program supported by a large science museum. Based on the data we collected, we provide a snapshot of how we interpreted that data and identify professional learning needs and possible resources for the science teacher leaders in the program.

## Introduction

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Teacher leadership has become an important factor in the improvement of science education (Whitworth et al., 2022). Science teacher leaders (STLs) are classroom teachers or former classroom teachers who work within and beyond the classroom to improve science learning opportunities and outcomes for students (Luft et al., 2016; Wenner, 2017; Whitworth et al., 2022). STLs can be classroom-based teachers who work to innovate their instructional practice (“instructional innovators”), “professional learning leaders” who support other science teachers both locally and beyond to improve their science instruction, and “administrative teacher leaders” who work on systems-level change and science implementation improvement (Bae et al., 2016). STLs usually fall primarily into one of these three categories; however, they often enact practices and aspects of the other two (Bae et al., 2016; Heredia et al., 2023).

STLs’ roles are context-dependent and vary according to personal interests, preparation and experiences, and local priorities for science learning (Lewthwaite, 2006; Sinha & Hanuscin, 2017). This variation in roles for STLs means they come to professional development (PD) opportunities for different reasons (Luft et al., 2016). For example, classroom STLs may have different leadership roles that depend on their personal interests or the geography of their district. Rural math and science teacher leaders report wearing multiple leadership hats, noting the multiple opportunities they must engage in different kinds of leadership due to a

lack of resources in the district (Lotter et al., 2020). These STLs can feel more isolated in their work and seek out PD to network with other leaders and locate resources needed by their school or district (Lotter et al., 2020). Innovative teachers seek out PD opportunities to learn about new and different science teaching strategies for their classroom, often driven by a personal interest in the content and to improve their teaching (Bae et al., 2016; Howe & Stubbs, 2003). The STLs in the aforementioned studies (e.g., Howe & Stubbs, 2003; Lewthwaite, 2006; Lotter et al., 2020; Luft et al., 2016; Sinha & Hanuscin, 2017) were classroom STLs who were working to improve science education, and their context provided them with different kinds of opportunities to engage in leadership activities. In turn, they likely had different needs when seeking PD for their leadership work.

These are only two examples of the potential variation in leadership practices that are possible in the context of a PD program for STLs. This suggests that a one-size-fits-all PD program will not be productive for all STLs (Luft et al., 2016) and that professional learning opportunities need to be differentiated for and responsive to STLs' individual needs and interests (Sinha & Hanuscin, 2017). To do so, science teacher educators need mechanisms to understand STLs' leadership practices to design productive professional learning resources that attend to their personal interests, professional needs, and the constraints of their school contexts (Klein et al., 2018; Whitworth et al., 2022). This article provides one such mechanism to identify the roles and needs of STLs while they engage in their own professional learning.

## **Identifying as a Science Teacher Leader**

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Definitions of science teacher leadership in the literature vary and often build on a general definition of a teacher leader as a teacher who works in and beyond their classroom to effect change within schools and to improve student learning (Katzenmeyer & Moller, 2009; Whitworth et al., 2022). Leadership is especially important in science education because STLs have content knowledge and pedagogical experience that other school leaders may not have (Stein & Nelson, 2003). Similarly, STLs engage in leadership activities unique to science education, including the management of learning materials, monitoring safety regarding lab equipment and activities, and the need to advocate for resource allocation to science within schools and districts because of the hyper-focus on ELA and math and other factors (Criswell, Rushton, Nachtigall, et al., 2018; Wenner, 2017; Whitworth et al., 2022).

Teachers can develop as leaders formally, through appointments to specific roles in their school or district (Bae et al., 2016; Wenner, 2017), or informally, through sharing resources with their colleagues (Howe & Stubbs, 2003). A key feature of the development of STLs is their identification as a leader (Criswell, Rushton, McDonald, et al., 2018; Sinha & Hanuscin, 2017; Wenner & Campbell, 2018). However, not all STLs with leadership positions identify as leaders, which can have consequences for their professional learning and development as a leader (Hanuscin et al., 2011; Klein et al., 2018).

Participants' own definitions of teacher leadership both helped and hindered them in how they viewed their work, who they brought in to work with them, and how they asked for support. When teacher leaders had clearly defined notions of teacher leadership, the projects were more easily developed and enacted, and participants found more support for their work. One implication of this finding might be that emerging teacher leaders need time to explore how they define teacher leadership and opportunities to unpack those definitions so they can better understand how they might influence teacher leadership work. (Klein et al., 2018, p. 110)

Given the literature that suggests the importance of STLs' recognizing and identifying themselves as leaders, we developed an activity for STLs to identify the leadership roles they enact in their work and the roles they would like to develop further.

## Science Teacher Leader Role Identification Activity

In our work with STLs supporting the implementation of the *Next Generation Science Standards* (NGSS; NGSS Lead States, 2013) across a large state, we identified seven leadership roles: activist, ambassador, collaborator, innovator, networker, organizer, and translator (Heredia et al., 2023). Each role highlights a set of practices that STLs enact as part of their leadership work. STLs generally hold more than one role with special emphasis on one or two primary roles and additional roles that support those primary roles. Table 1 summarizes the practices of the seven roles.

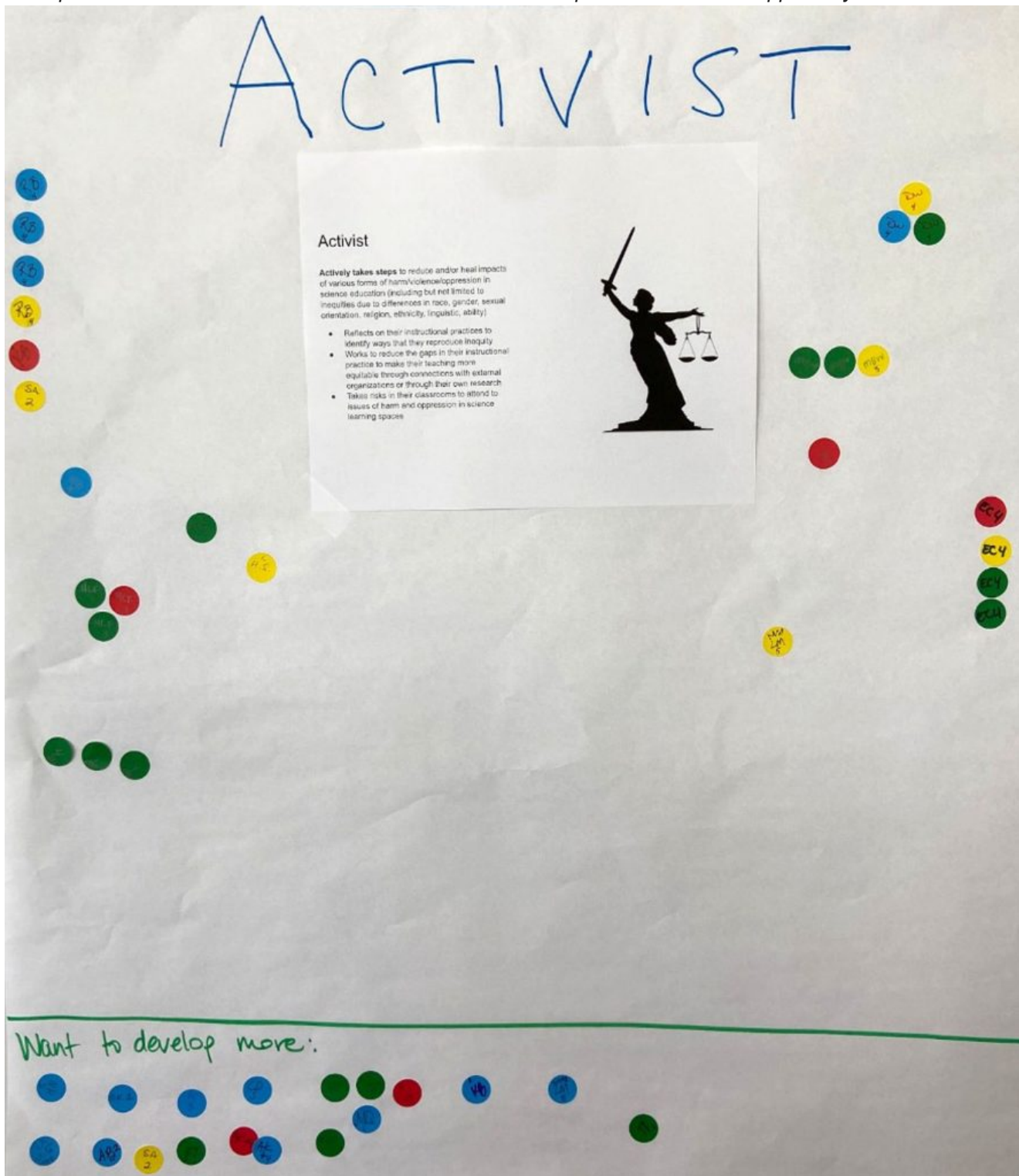
**Table 1**  
*Seven STL Roles and Identified Practices Shown to Teachers in the Activity*

| Role         | Practices                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Activist     | Actively takes steps to reduce and heal impacts of various forms of harm and oppression in science education. <ul style="list-style-type: none"> <li>• Reflects on their instructional practices to identify ways that they reproduce inequity.</li> <li>• Works to reduce the gaps in their instructional practice to make their teaching more equitable through connections with external organizations or through their own research.</li> <li>• Takes risks in their classrooms to attend to issues of harm and oppression in science learning spaces.</li> </ul> |
| Ambassador   | Is the "go-to" person for NGSS or equitable science instruction in their district or school. <ul style="list-style-type: none"> <li>• Mentors student teachers and beginning teachers into the profession of science teaching.</li> <li>• Opens up their classroom to observation and/or models instruction during professional development.</li> <li>• Is often the only science person at the table, and makes sure that science is attended to at the district and administrative levels.</li> </ul>                                                               |
| Collaborator | Works with other teachers or district leaders to coordinate and implement reform efforts. <ul style="list-style-type: none"> <li>• Collaborates on developing or choosing curricula for science reform.</li> <li>• Coaches teachers in their instructional practice, working side-by-side with teachers to modify and improve their instructional practice.</li> <li>• Collaborates intentionally and strategically with administrators for extra leverage when necessary to further their work with teachers.</li> </ul>                                             |
| Innovator    | Works to locate or develop new and innovative ideas and practices to bring to their context to support science education reform. <ul style="list-style-type: none"> <li>• Identifies problems of practice, and develops solutions to those problems within their school or district context.</li> <li>• Tries out new and innovative practices in their classrooms.</li> </ul>                                                                                                                                                                                        |
| Networker    | Connects teachers, schools, and/or districts to social and material resources. <ul style="list-style-type: none"> <li>• Knows what resources are available, and connects teachers with those resources.</li> <li>• Connects with outside resources, and then shares with others in their context.</li> </ul>                                                                                                                                                                                                                                                          |
| Organizer    | Coordinates the logistics of science reform initiatives dictated by their district and/or school. <ul style="list-style-type: none"> <li>• Shares information and resources about the district- or school-based decisions with teachers.</li> <li>• Plans professional learning opportunities to ensure that teachers are gaining the knowledge and receiving the support they need.</li> </ul>                                                                                                                                                                       |
| Translator   | Provides coherence across their organizations, and acts as a liaison between administrators and teachers to translate policy to practice. <ul style="list-style-type: none"> <li>• Has a vision of science education that "fits" with other district policies.</li> <li>• Develops systems of communication between administration and teachers to enact that vision.</li> <li>• Collects and analyzes data on improvement efforts, and seeks feedback from the teachers they work with on improvement efforts.</li> </ul>                                            |

To start the activity, STLs were introduced to these roles through a PowerPoint presentation and were asked to identify the roles they occupied in their leadership practice. We instructed the STLs to use colored stickers with their initials to identify their leadership roles on the seven posters around the room. Each poster included a description of that role and designated spaces for STLs to place stickers for roles they occupied and roles that they would like to develop (see Figure 1). Each STL was given 12 stickers: 10 to use to indicate which roles they identified with and two to identify roles they wanted to develop further. We asked them to weigh their choices by putting more stickers under a role they strongly identified with and fewer or no stickers on roles they identified with the least or not at all. We instructed STLs to weigh their choices because we have found in previous work (Heredia et al., 2023) that STLs prioritize certain roles over others. The number of stickers they put under each role helped us to understand how they distributed their time and their priorities for their leadership practice.

**Figure 1**

*Example Poster for the Role of Activist With the Role Description and Stickers Applied by STLs*



After the STLs placed their stickers, we asked them to stand near one of the posters they weighted heavily in their leadership practice and have a conversation with other STLs about that role. We provided the following prompts for their discussion.

1. Why did you choose that role?

2. What aspects of your leadership practice align with this role?
3. What critical events, people, or materials led you to this role?

Next, we asked them to stand next to a poster for a role they wanted to develop more and discuss why they wanted to develop that role more and what resources they needed to do so.

## **Sample and STL Context**

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We used the role identification activity with a group of 27 STLs who were selected from a network of STLs supported by the Exploratorium, a large museum located in San Francisco. The network was started by the museum in 2016 to support the implementation of new science standards across California (for more information on the STL network, see <https://www.exploratorium.edu/education/caeducators/workshops>). As part of the network's opportunities for professional learning, the STLs applied and were accepted into an online community of practice that met monthly over the course of one academic year to work on a problem of practice identified by the STLs (Heredia et al., 2022). The professional learning program culminated with an in-person event at the museum in May during which STLs reflected on and shared their work with one another. The role identification activity provided an opportunity for STLs to reflect on their work and consider what aspects of their leadership practice they would like to develop further. This activity helped the museum staff identify possible areas of professional learning to focus on in future PD opportunities. A total of 32 STLs participated in the online professional learning program. Of those STLs, 27 participated in the final in-person workshop where they engaged in the role identification activity. The STLs who participated in the activity represented various districts and counties across the state, as well as rural to urban contexts.

## **Process for Compiling and Analyzing Data From the Activity**

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During the activity, conversations were audio-recorded at each poster location. Additionally, researchers were also stationed at each location to take field notes. The field notes captured who was at each poster for each discussion and important practices, resources, and challenges for each role discussed by the STLs. After the activity, we compiled data from each of the posters into a table to record the number of stickers each STL put on each poster. We sorted STLs into two groups according to their primary area of influence (classroom or district) related to their position (Bae et al., 2016). In our sample, there were 14 classroom STLs and 13 district STLs.

We tabulated the number of stickers each STL placed on each role and organized the data in an Excel spreadsheet. First, we counted the number of classroom and district STLs who placed at least one sticker on each role. Next, we calculated the weighted choice for each group of STLs to understand the relative importance each group put on the different roles. We did this by calculating the percentage of stickers placed for each role according to STLs'

leadership type, classroom, or district STL. For example, we added up all the stickers the classroom STLs placed on the ambassador poster (32 stickers) and divided the total by the total number of stickers placed by the classroom STLs across all the roles ( $n = 134$ ; some classroom STLs did not use all their stickers). We followed the same process for district STLs, as a group they placed 24 stickers on the ambassador poster, which we divided by the 123 stickers they collectively placed across all the roles (like classroom STLs, not all district STLs used all their stickers). Then, we followed a similar process to identify the percentage of stickers that STLs placed on roles they wanted to develop more. All but one district STL placed two stickers on roles they would like to develop more ( $n = 24$ ). Similarly, all but one classroom STL placed at least two stickers on roles they would like to develop and one classroom STL identified four roles they want to develop more for a total of 28 stickers placed for this group. We also counted the number of roles each STL identified in their work and calculated the average, mode, and range of the number of roles identified by STLs in each category.

Next, we analyzed data from the audio recordings and field notes to identify leadership practices described by STLs at each poster, resources that supported that work or that they described needing more of, challenges they described related to each role, and connections to other leadership roles they identified with. We focused on these aspects of their discussion to identify assets and resources STLs brought to their professional learning as well as any needs they might have for their professional learning.

## What We Learned

The descriptive data suggest that the district STLs were more similar in the number of roles they identified as compared with the classroom STLs (see Table 2). On average, the classroom STLs identified four different roles that they occupy in their leadership practice, and the district STLs identified five different roles. The mode for both groups was five roles, meaning that most STLs in our sample identified five different roles they occupy in their leadership work. The range of the number of roles identified by the two groups was five for the classroom STLs and three for the district STLs.

**Table 2**

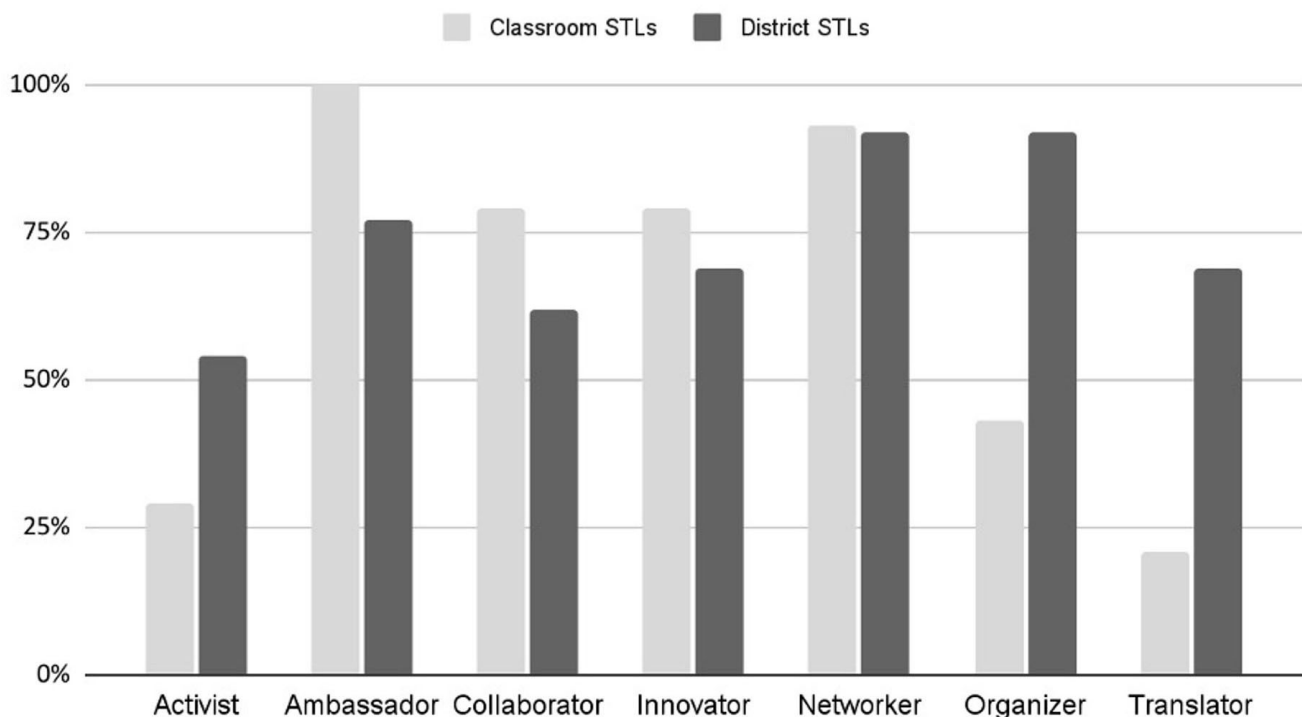
*Descriptive Data for the Number of Roles Identified by Classroom and District Science Teacher Leaders (STLs)*

| Type of STL    | $n$ | $M$ | Mode | Range |
|----------------|-----|-----|------|-------|
| Classroom STLs | 14  | 4   | 5    | 2–7   |
| District STLs  | 13  | 5   | 5    | 4–7   |

The role identification activity provided some insights into similarities and differences among and across groups of STLs in our leadership PD program. The two groups occupied similar roles and diverged from one another in a few important ways (see Figure 2). Most of the STLs in both groups identified the ambassador role as one they occupied (100% classroom STLs and 77% district STLs). Similarly, most of the STLs identified the innovator (79% of classroom STLs and 69% of district STLs) and networker roles (93% of classroom STLs and 92% of district STLs). More district STLs identified the role of translator (69%) and organizer (92%) compared with only 21% of classroom STLs for the translator role and 43% for the organizer role. Another notable difference is in the activist role. More than half of the district STLs (54%) identified the activist role as one they occupied in their leadership practice compared with only a quarter of the classroom STLs (29%).

**Figure 2**

*Percentage of Classroom STLs and District STLs Who Occupied Each Role*

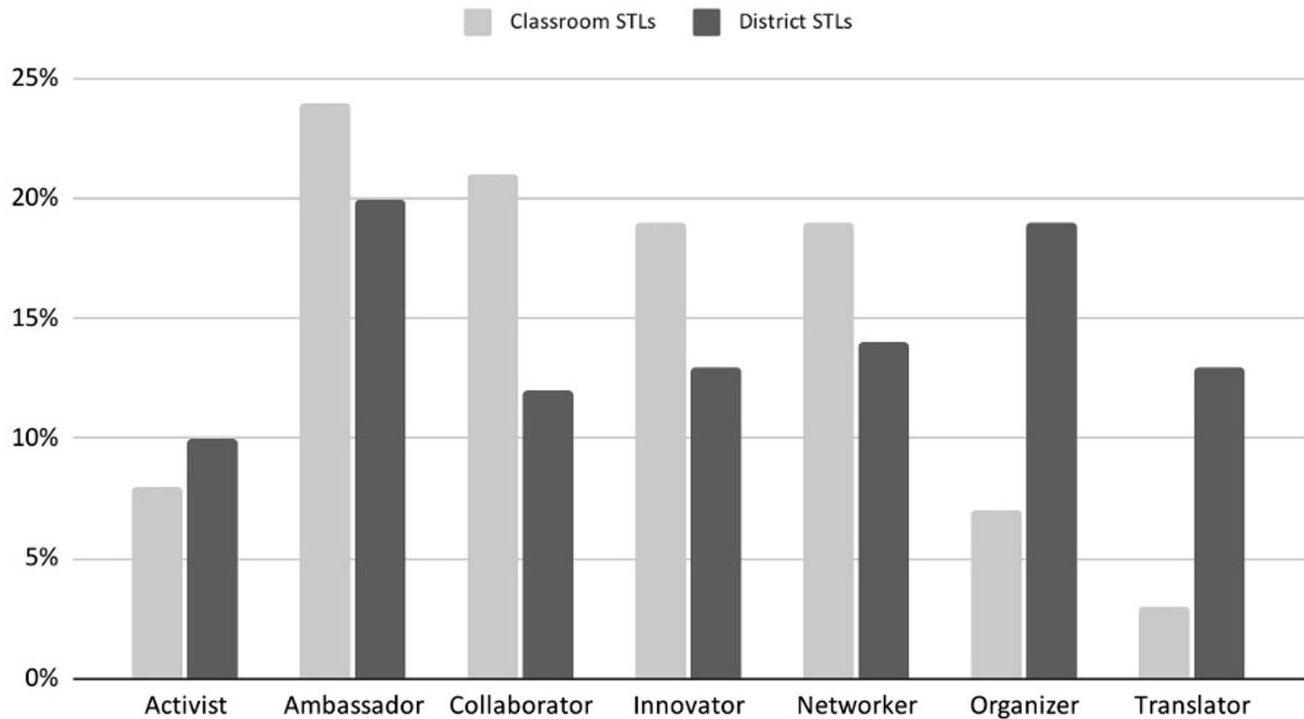


When comparing the weighted percentages for each role within groups (classroom or district), interesting patterns emerged (see Figure 3). The district STLs' roles were more evenly distributed in their work. The roles of ambassador (20%) and organizer (19%) were prioritized more by district STLs than their other roles but only to a small degree. The district STLs weighted the roles of activist (10%), collaborator (12%), innovator (13%), networker (14%), and translator (13%) as similar priorities in their leadership practice. The classroom STLs demonstrated more variation in how they prioritized their various roles. Similar to the district STLs, the classroom STLs weighted their role as an ambassador (24%) more heavily than their other roles. However, they weighted their roles as collaborators (21%), innovators (19%), and networkers (19%) as higher priorities than the district STLs did. Interestingly, the weighted percentage for the activist role was similar between groups (8% of classroom STLs

and 10% of district STLs), which suggests that the four classroom STLs who identified themselves as occupying the activist role weighted it higher than other roles they occupied (see Figures 2 and 3).

**Figure 3**

*Weighted Roles for Classroom and District STLs*

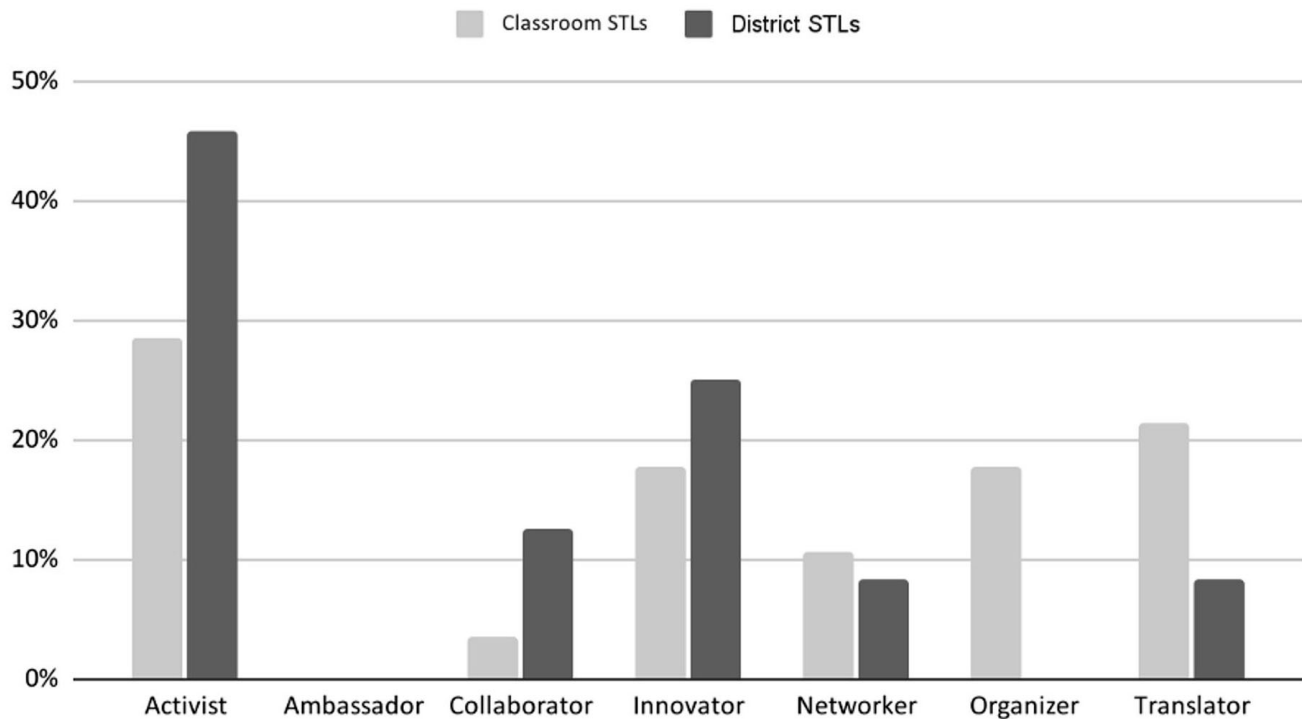


*Note.* Weighted roles were determined by dividing the number of stickers that STL type placed on the role poster by the total number of stickers placed on all posters by that STL type.

Lastly, there were some key differences and similarities between groups of STLs when identifying roles they would like to develop more in their leadership practice (see Figure 4). More classroom STLs (21%) identified the translator role as one they wanted to develop more, whereas few district STLs identified this role as one they wanted to develop (8%). None of the district STLs wanted to develop their role as an organizer, whereas 18% of classroom STLs identified organizer as a role they wanted to develop more. Similarities between groups in roles they wanted to develop more included the activist role (29% of classroom STLs and 46% of district STLs) and the innovator role (18% of classroom STLs and 25% of district STLs).

**Figure 4**

*Weighted Choices of Roles That Classroom and District STLs Wanted to Develop More*



## Poster Discussions

Rather than describe all the conversations that happened, we home in on a few of the conversations around interesting patterns in the poster data from the perspective of an STL educator. We focus on the activist because this was the number one role both classroom and district STLs wanted to develop further and on the translator role because this was the second highest role that classroom STLs wanted to develop further. We also look at the innovator role because it was a role identified by the majority of the STLs as one they occupy, but the district STLs noted they needed more development in this area.

### Activist Role

Only two STLs chose to discuss the activist role as a role they occupied in their leadership work, one classroom STL and one district STL. They discussed at what level of the system they do their activist work. The classroom STL discussed how, for her, activism included creating possibilities where there weren't any for her students. She focused on the lack of opportunities her students had to go outside and investigate their environment and how that has impacted their interest in science. The district STL at the poster talked about her activism at the systems level. Both agreed that a big part of their activist work was not accepting the status quo and supporting others to do the same. "For [students] to be able to see it, and for me, the next level is for them to question it. Really figure out why is this not working instead of just accepting the way things are" (Classroom STL). They also discussed the importance of the translator role for their activist work in schools because they had to be able to communicate to different audiences.

The activist poster was by far the most populated for both district and classroom STLs when they were asked to go to a poster with a role they wanted to develop more. When discussing their needs related to developing this role more in their leadership practice, the STLs focused on a lack of resources for this work, a need to better understand the educational system and their influence within that system, the disconnect between university education programs and what happens in practice, and the feeling of being isolated in their work. The COVID-19 pandemic played a large part in their discussion. As one district STL noted, “COVID has really shown us about some of the inequities that we knew existed [ . . . ] We can’t let that continue.”

They also made a distinction between activism in relation to the recruitment and retention of teachers of color and the activist work they do in the classroom with students. One district STL noted, “I think there are different levels of activism too [ . . . ] our district is very difficult to change things.” This led a classroom STL to jump in and add, “I like that you brought up the levels of an activist because I can be an activist just in my own classroom.”

### ***Translator Role***

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The STLs who weighted this role as important in their work were all district STLs. They discussed the importance of communication with both teachers and administrators about policy, values, and vision as it relates to science education. A big part of this communication included creating alignment between these different parties to identify how reform efforts fit with larger district efforts and school culture. One district STL talked about how the turnover of administration influenced their communication with teachers:

I work as an instructional coach for science teachers K–8 and plan PD for middle school science teachers [ . . . ] Teachers get lost in the shuffle. One of the things we experienced was frustration and anxiety about the lack of communication with new administrators. I’ve had to be more of a translator this year, take some of that institutional knowledge and appreciation for what teachers feel and know and communicate back and forth between groups to lower anxiety and hopefully do some perspective-building.

The other STLs at this poster agreed and noted that turnover at the teacher level also called on the STLs to be translators. They discussed how the translator role aided them in onboarding new teachers into the school or district and supporting those new teachers in aligning their classroom practices with the vision for science education based on policy and district efforts. STLs also stressed that translation happens bidirectionally to ensure that both the teachers’ and districts’ perspectives are communicated. One district STL connected their role as a translator to their role as a collaborator (noting that they weighted these roles equally) because they spent the bulk of their time working with teachers to translate district policy into their classroom practice.

Two STLs discussed their need to develop the translator role from two different perspectives. One was a classroom STL who connected this role to her role as an innovator. She talked about the need to have different ways to translate innovations from her classroom to others: “How can I be a conduit so that there is an understanding between what teaching is like in a classroom and the vision of the school? Sometimes there is a big disconnect, and students are the ones that suffer.” The other district STL discussed her need to develop this role in relation to her ability to communicate to multiple audiences about NGSS and visions for science education: “Being able to talk the language of the administrators and link their values to the values that really matter.” Both STLs discussed needs related to communication and mechanisms for getting feedback from multiple sources, including students and families.

### ***Innovator Role***

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The STLs who discussed the innovator role as their primary role were all classroom STLs. They noted the importance of taking risks, recognizing the need for change, and not always wanting to do the same thing. Their focus was their students and working to make the learning experiences the best they could for the students they serve: “We try to find the thing that works the best, empowers [students] to solve real-world problems [. . .] You have to be bold and get it done for your students.”

The STLs at this poster also discussed the importance of their networks, local and national organizations for science teachers, and grant opportunities as key to their roles as innovators. One classroom STL noted, “Through leadership at conferences and at NSTA, I’ve been able to get grants to fund innovation.” Although they talked about getting new ideas and support for developing new strategies through their networks, they also talked about the importance of being able to share their innovations with other teachers through these organizations and networks.

Three district STLs and one classroom STL chose this role as one they wanted to develop further. A central theme in their discussion revolved around the importance of risk-taking for innovation and the ways in which the system deterred teachers from taking risks. One district STL said:

There is a level of risk that teachers are not willing to take. It might be from the trauma or their comfort level with what they have now. Our role as leaders is to advocate for some way for them to feel safe taking those risks.

The classroom STL agreed and described how she loved creating new activities and resources for her students, but burnout of the other teachers she worked with impacted her ability to collaborate with them to innovate. Overall, risk-taking was an important theme across the STLs who identified themselves as innovators and those who wanted to develop that role further.

## Discussion

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The role identification activity provided a snapshot of the variation in leadership roles across and within groups of STLs in our professional learning program, which is consistent with other studies of science teacher leadership that identified variation in the roles of STLs (Luft et al., 2016). However, there were notable areas of convergence and divergence across the different groups that could be leveraged in designing for their professional learning. Rather than make claims about this particular group of STLs and their leadership efforts, we offer our interpretation of the findings as science teacher educators and offer some suggestions about how this data could be of use to design future professional learning opportunities.

The activist role was identified by both groups as one they would like to develop more, which speaks to the lack of resources and education for science teachers to learn about and discuss issues of inequity, harm, and racism in science education (Mensah & Jackson, 2018). To attend to this need, science teacher educators could create opportunities for STLs to not only reflect on and address the actions and instructional practices that reproduce inequities (Calabrese Barton & Tan, 2020; Kishimoto, 2018) but also to learn how to support other teachers to do so. The conversations between STLs who wanted to engage more with this role centered around two different areas for activist work: the classroom and the recruitment and retention of teachers of color. They also highlighted that STLs felt isolated in their activist role, which suggests that building networks or communities of practice specifically related to this work could be one avenue to support STLs (Bae et al., 2016; Heredia et al., 2022).

We also learned that, when selecting a role they wanted to develop more, both groups of STLs identified a role that the other group had selected as a role that was weighted heavily in their leadership. For example, classroom STLs wanted to develop in the translator role, whereas district STLs felt they already occupied this role. District STLs wanted to develop in the innovator role, whereas classroom STLs felt they already occupied this role. This suggests that these groups have something to learn from one another regarding their leadership practice. PD providers could create opportunities for STLs who occupy certain roles to share resources (ideas, routines, and practices) that support that aspect of their leadership practice with STLs who would like to develop that role more (Heredia et al., 2022). Lastly, separating the data according to their area of influence (classroom or district) helped us see that there were more similarities within the group of district STLs and more variation within the group of classroom STLs. This suggests that these two groups may have different professional learning needs and require choice in PD options (Sinha & Hanuscin, 2017).

## Conclusions

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This article provides an activity to support STLs in identifying the roles they take up in their work and their professional learning needs. We provide a mechanism to understand the variation that likely exists in the landscape of science teacher leadership and for science

teacher leaders to identify the skills and practices they would like to strengthen. This activity further aims to amplify and support the work of STLs as we develop tools that will help them identify their professional learning needs in relation to their specific leadership practice as it is organized in their contexts.

## Acknowledgments

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This material is based upon work supported by the National Science Foundation under Grant No. 1907460. Any opinions, findings, conclusions, or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation. We also acknowledge and thank the science teacher leaders without whom this work would be impossible.

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